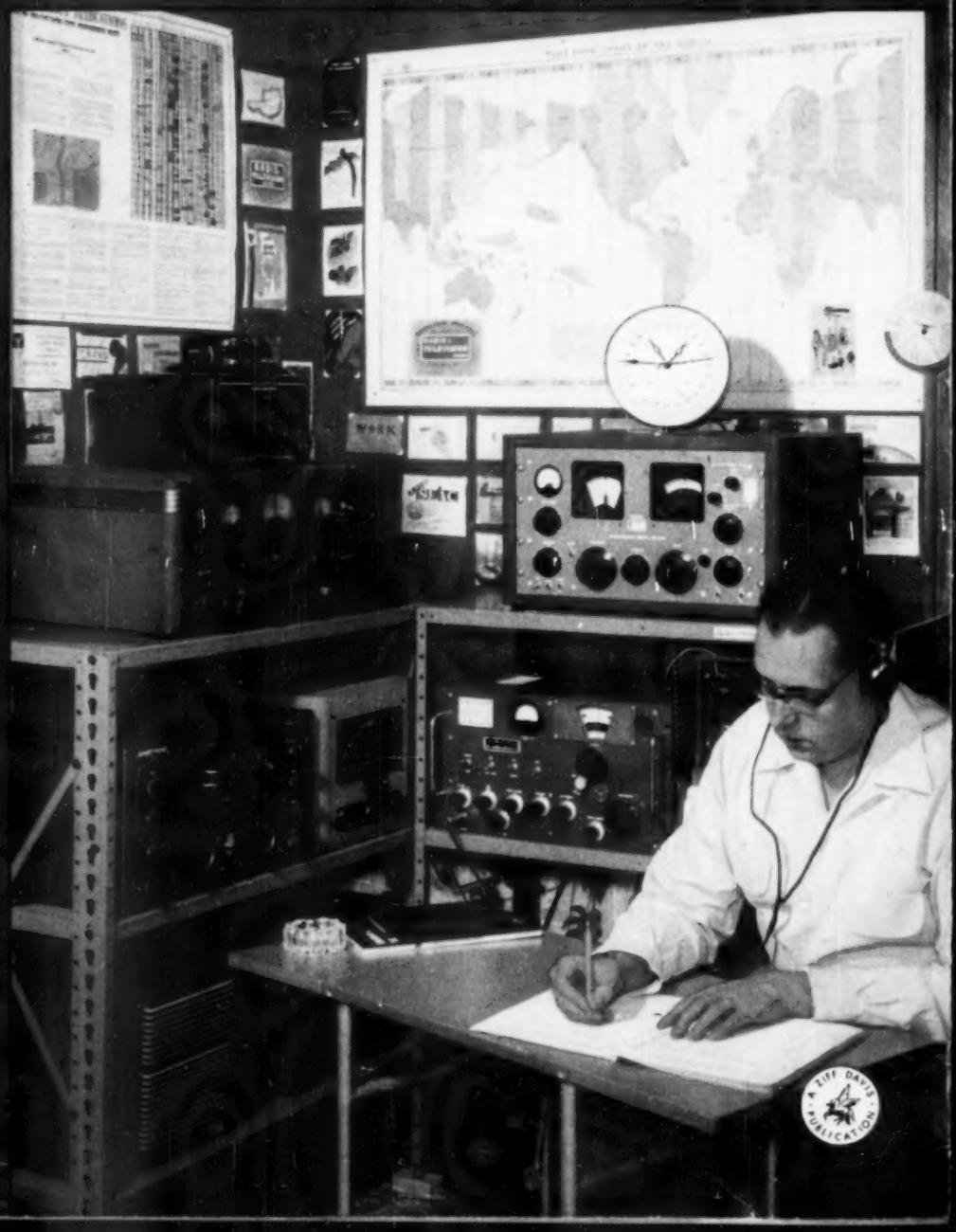
RADIO & TELEVISION NEWS

IN THIS ISSUE



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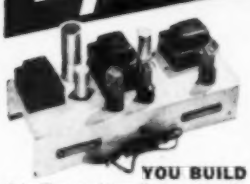

YOU BUILD this Transmitter Power Supply used in the basic experiments in RF and AF amplifiers, frequency multipliers, buffers, etc.

YOU MEASURE current, voltage (AC, DC and RF), resistance and impedance in circuits with Electronic Multitester you build. Shows how basic transmitter circuits behave; needed to maintain station operation.

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YOU BUILD this Wavemeter and use it to determine frequency of operation, make other tests on transmitter currents.

Get Practical Experience on Circuits Common to Radio & TV

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Even without Television the industry is bigger than ever before. 105 million home and auto radios, 2900 Radio Broadcasting Stations, 108 TV Stations with 1800 more now authorized. Expanding use of Aviation and Police Radio, Micro-Wave Relay, Two-Way Radio for buses, taxis, etc. makes opportunities for Communications Technicians and FCC Licensed Operators. New jobs, more jobs for beginners! Better jobs, better pay for experienced men!

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Transmitter Operator
Service Technician

AVIATION RADIO
Plane Radio Operator
Airport Transmitter Operator

TELEVISION
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Voice Transmitter Operator
TV Technician
Remote Control Operator

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CONTENTS — JUNE, 1953

V.H.F. Communications in Korea	*1st Lt. Richard G. Gould*	35
Using a Transistor to Increase Relay Sensitivity	*Louis E. Garner, Jr.*	39
Why Use a Condenser?	*Rob Wagner, W6WGD*	40
Tunable Hum in Broadcast Receivers	*Sidney Wald*	42
Equalizer-Preamp	*Arthur J. Rose*	43
A $5 Low-Pass Filter	*J. G. Rountree, W5CLP*	47
D.C. Distribution in TV Receivers	*Walter H. Buchsbaum*	48
TV Parts Replacement Guide		51
Transistor Band Spotter	*Peter G. Sulzer, W3HFW*	52
Noise Immunity Circuits (Part 2)	*Milton S. Kiver*	54
Lie Detector	*Edwin Bohr*	56
Know Your 1953 Philco TV Receivers	*Dan Lerner*	58
The Fisher Master Audio Control	*John R. Russell*	62
Electro-Voice Aristocrat	*Howard Souther*	64
Three Watts in a Coffee Can	*Jim Fahnestock, W2RQA*	66
Mac's Radio Service Shop	*John T. Frye*	68
An Oscilloscope Calibrator	*Richard Graham, W1VJV*	70
A Novel Probe Switch	*Milton White*	72
G-E's Internal Magnetic Focus System		82
New TV Grants Since Freeze Lift		84
Time Compressor		96
4-Channel Continuous Recorder-Reproducer		100
Service Hints on Philco TV Sets		120
New TV Stations on the Air		124
Radio-TV Service Industry News		154

DEPARTMENTS

For the Record	*The Editor*	8	What's New in Radio	77
Spot Radio News		14	Manufacturers' Literature	88
Within the Industry		24	New TV Products	134
Short-Wave	*K. R. Boord*	69	Technical Books	149

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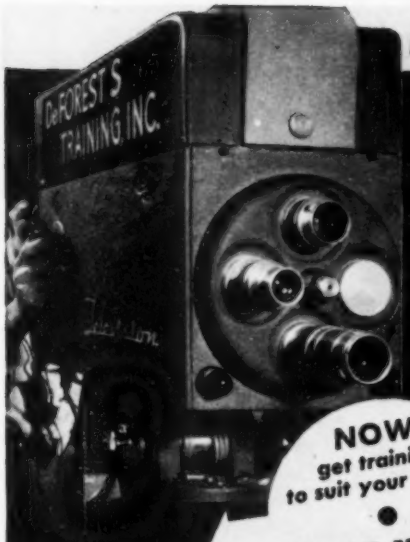

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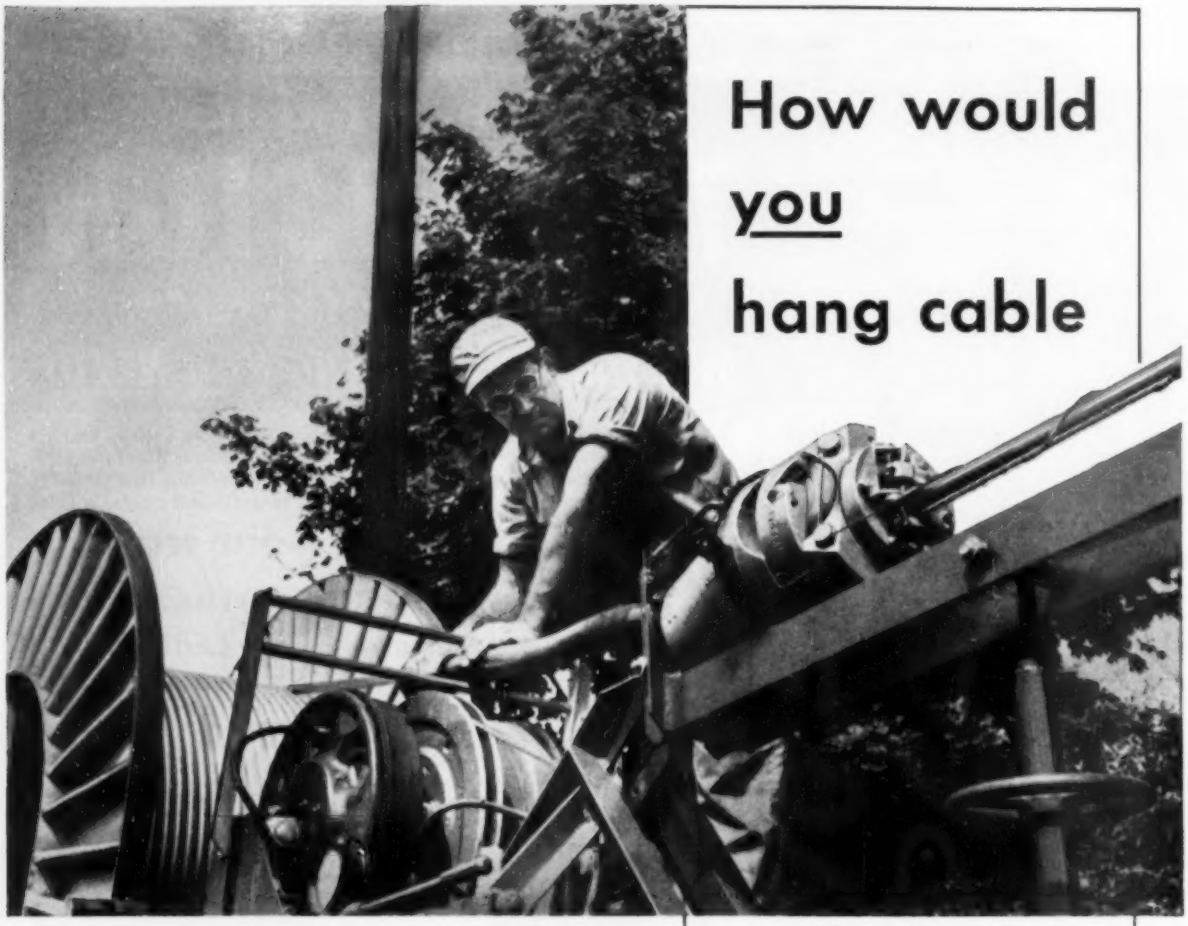

How would you hang cable ...by the mile?

Cable lasher appears to right of workman. As the cable and supporting strand feed through, the machine rotates, binding them together with steel lashing wire. Meanwhile, a winch hauls the lashed cable into position.

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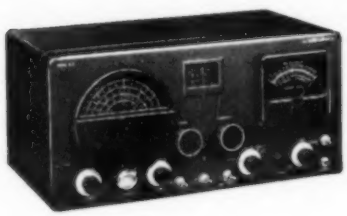

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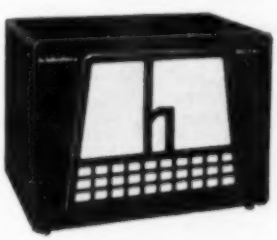

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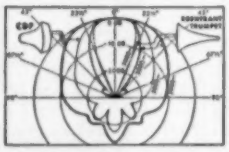

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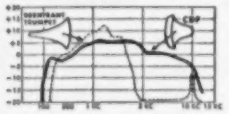

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For the RECORD

BY THE EDITOR

ELECTRONICS AND RELIABILITY

WE HAVE all heard a great deal in recent years about the importance of "reliability" in electronic equipment. All too often, though, this factor is minimized in new equipment design and engineering with the major emphasis being placed on immediate performance. This has resulted in unreliable equipment being placed in service.

There are many different degrees of reliability to be considered. For example, there is seldom any danger to life and limb when the television set ceases to operate, or when a p.a. system quits. But when the navigation equipment on an intercontinental bomber fails, it can result in the loss of the plane and many lives. In the first case, the problem is an economic one—we must build in as much reliability as the customer is willing to pay for. In the second case, we must approach 100% reliability as closely as possible, regardless of cost. It is interesting to note that a flight of 30 large bombers on a 15-hour mission involves about 1 *million* tube-hours of operation!

There are several possible approaches to the problem of "reliabilizing" electronic equipment. Any final design should incorporate all of these approaches, as well as any others which are available.

Simplifying equipment will, in general, make it more reliable because of the fewer number of components, fewer soldered joints, and the greater dependence on "tried and true" techniques. Many times a piece of equipment is designed to do things which may be convenient but not necessary. The added complexity tends to decrease reliability, requiring further protective equipment, or units to take over in case of failure. This results in greater complexity, calling for still more protective equipment, and so on. Every function of the equipment must be considered carefully, and if not necessary, such a function should be eliminated. Extra frills and reliability are not compatible.

Improving the reliability of individual components is also a fertile approach. Great strides have been made in this direction in recent years. Hermetic seals, improved insulation, new dielectric materials—all have been used to increase the life expectancy of coils, condensers, resistors, transformers, and other components. Ruggedizing has been applied to vacuum tubes with highly satisfactory results. However, the practice of over-rating components still exists. Thus, a 600 volt condenser is used where a 200 volt unit should do the job and a 2 watt resistor is specified when the actual dissipation never exceeds ¼ watt. Components are designed to give optimum life when operated at or near their ratings and such over-rating is not necessary. In this connection, it should be noted that many failures in electronic equipment have been traced directly to misuse of components.

The use of "failure prediction" tests or "marginal checking" has increased rapidly in recent years. Such tests can be used to predict the imminent failure of a tube or other component so it can be replaced before failure actually occurs. This method has been used to increase the reliability of complex equipment (such as electronic computers) by a large factor.

Transistors can be used very advantageously in "reliabilizing" equipment. Previous limitations of temperature, frequency response, uniformity, and power handling capacity are rapidly being overcome. One manufacturer has demonstrated a transistor operating satisfactorily at the temperature of boiling water; another has developed a tetrode junction transistor which will oscillate above 250 mc.; another has developed techniques for air-cooling transistors so that dissipations of one watt or more are permissible; several manufacturers are mass-producing transistors with satisfactory uniformity.

Improved reliability does not depend solely on the increased life and ruggedness of the transistor itself. Less power is required, resulting in less heat dissipation and lower operating temperatures. Because of the low power requirements, the equipment can be operated on batteries, placing less dependence on external sources of power, plugs, and connectors. Lower voltages can be used, with less strain on insulation and other components such as condensers, resistors, etc.

Too much emphasis cannot be placed on this concept of reliability, particularly with respect to military and industrial electronic equipment. Many people outside our field (and inside, too!) feel that electronic equipment is essentially fragile and unreliable and should be used only as a last resort. Overcoming this basic philosophy will require a great deal of intensive engineering on the reliability problem. When electronic equipment has attained the reliability now achieved with mechanical equipment, we can truly say that our industry has reached maturity . . . . O.R.

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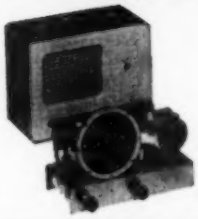

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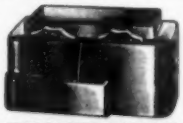

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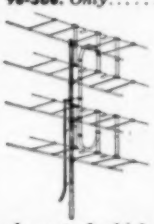

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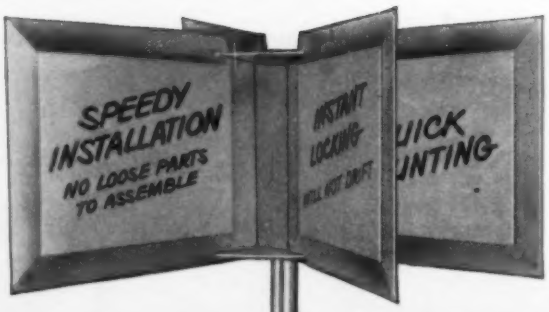

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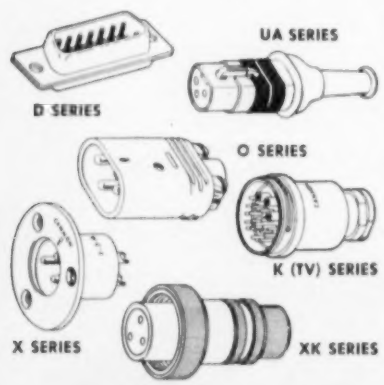

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Spot Radio News

*** Presenting latest information on the Radio Industry.**

By RADIO & TELEVISION NEWS' WASHINGTON EDITOR

COLOR TV, the perennial problem child of industry and Congress, too, whose committees have investigated and re-investigated its "delayed" full-scale debut, found itself on Washington's hottest griddle a few weeks ago, when members of the House opened a sizzling inquiry into the exact reasons for the prolonged hibernation of the reds, greens, and blues.

Three factors were cited as the cause for the latest outburst and hunt for information: A color TV test report, issued during the summer of '52, disclosing that superior performance was now available on an industry-approved compatible scheme; the contradictory M-90 ruling of NPA declaring that defense commitments made it necessary to halt any production of disc-type chassis (no quantity production was under way in any plant at the time); and particularly a letter from Senator Edwin C. Johnson to Senator Charles W. Tobey, stating that "powerful interests" were deliberately delaying widespread use of colorcasting. Noting that . . . "it is a little less than three years ago since the Federal Communications Commission, the arm of Congress mandated to act in the public interest, adopted the standards for color television, and stated that it was here and that it should be made available to the public," the Senator asked why, in view of this official verdict, there still was no color TV. And he followed this query with four more direct questions: "Is this delay in manufacturing color receivers deliberate? Are the standards adopted by the Commission unsound? If so, in what manner? Have new standards been developed? If so, why are they not submitted to the FCC?"

It had been assumed that an immediate reply, in the form of a full-scaled inquiry, would be staged by a Senate committee. Instead, the House Interstate Commerce Committee, chairmaned by Rep. Charles A. Wolverton, raced onto the scene and declared that it would hold a public hearing on color TV to determine the basis for the repeated delays. Supported by Congressmen Carl Inshaw and James I. Dolliver, Rep. Wolverton began his session shortly after the Johnson letter appeared. Five of the industry's leading lights on colorcasting were summoned to Washington for a grueling "Q and A": Dr. E. W. Engstrom, *RCA* lab headman; *CBS* Prexy Frank Stanton; picture tube pioneer, Dr. Allen B. Du Mont; *Chromatic Lab* President Richard Hodgson; and *G-E*'s electronics division general manager, Dr. W. R. G. Baker, who is also chairman of the NTSC.

Appearing as the first witness, Dr. Engstrom testified that his company believed that compatible color TV was here and the Commission could legally approve such a system now. He pointed out that the FCC and its staff have been kept continually advised of the extensive research and development work which has been done on the system, not only by his company but by members of the NTSC. It would be wise, he felt, to authorize commercial broadcasts of not only compatible color signals now, but reinstate incompatible colorcasting too, so that the public could evaluate the two techniques.

Declaring that *RCA* had invested substantial sums in the establishment of a pilot operation for tri-color tube production in Lancaster, Dr. Engstrom noted that this manufacturing unit will have a production capacity of 2000 color tubes per month, and can serve as the prototype for other units in the establishment of factory facilities for large-scale, high-speed production.

Two color transmitting studios were said to be available for programming. One is located at *NBC* headquarters in Radio City and another in a theater which has been completely converted for color work.

Debonair Frank Stanton followed Engstrom and frankly admitted that *CBS* would support any color television system which works well, is practical, and has a reasonable cost. Such support would be forthcoming, even if the system were developed by a competitor. But, he added: "I cannot tell . . . whether we shall support the NTSC system . . . simply because we do not know enough about it, and hence we must reserve judgment."

And then, in a statement which rocked industry, he declared that . . . "reluctantly but realistically," *CBS* had no plans under present circumstances to broadcast or manufacture under the approved field-sequential system. Many factors were said to be responsible for this decision, particu-

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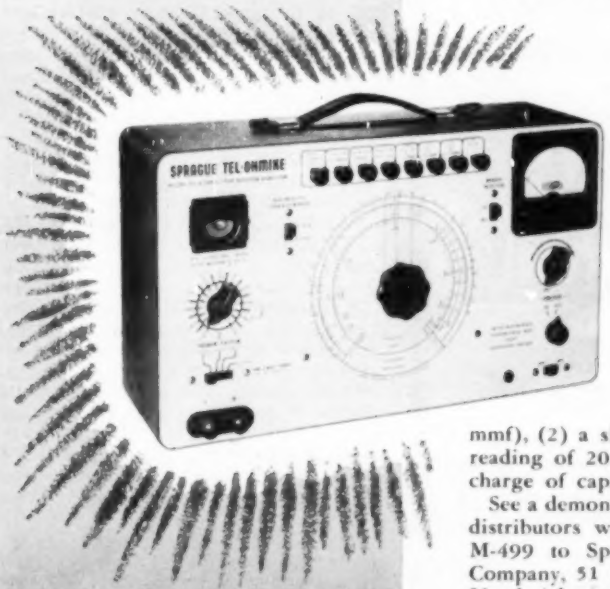

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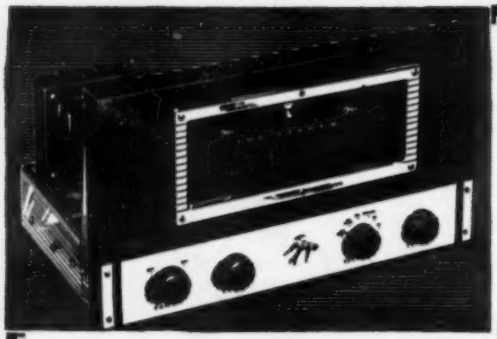

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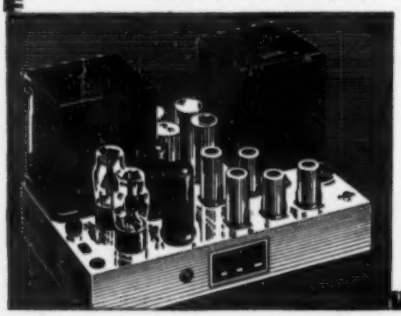

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larly the lack of industry support. "I think we would be tilting at windmills to undertake now . . . to try to pick up again where we were forced to leave off in October, 1951," he added.

His company had thought, Stanton went on, that the FCC decision would bring ". . . an end to the conflicting claims (as the FCC black and white decision had done in '41) and to the public's confusion and bewilderment which resulted from such claims. We had thought, and we had hoped, that our broadcasting and manufacturing efforts which cost us enormous energies and millions of dollars would supply enough impetus and competitive incentive for other broadcasters and other manufacturers to begin to follow our lead."

But the sequential system has been "completely becalmed" for the last year and a half, Stanton said, and black and white sets have increased to almost 23,000,000.

"I cannot minimize the problems which this creates," the *CBS* prexy continued. "I do not think that the problem of incompatibility is necessarily fatal. But I do think that the problem . . . has grown to such proportions that in combination with other factors, it becomes quixotic and economically foolish for us singlehandedly at this time to resume a large-scale broadcasting and manufacturing program."

The imminence of a compatible system was stressed as a key factor in arriving at such a decision. Explaining this situation, Stanton declared: "I think it would be wholly unrealistic for us to expect that no matter how vigorously or exhaustively we engaged in broadcasting or manufacturing under the field-sequential system, any other manufacturer would make sets under that system, or any substantial number of the public would buy such sets even if made, so long as there is the expectation that a new compatible system will momentarily be perfected and will be brought before the FCC."

To sprinkle the occasion with more confusion, NPA then announced that at long last it had decided to revoke its M-90 rule, making it possible for set makers to produce sets designed to receive sequential signals, that no one was broadcasting. Commenting on the revocation, Acting NPA Administrator H. B. McCoy pointed out that since June '52, manufacturers have been allowed to produce color TV sets under certain conditions, but no applications for such permission had been received.

"M-90 was invoked originally in November '51 to conserve both materials and engineering manpower for the nation's defense effort," McCoy declared. "With the easing of the materials situation in mid-'52, we amended the order to permit the manufacture of color TV sets by companies whose defense contracts were on schedule or by companies having no defense contracts who could show such

(*Continued on page* 143)

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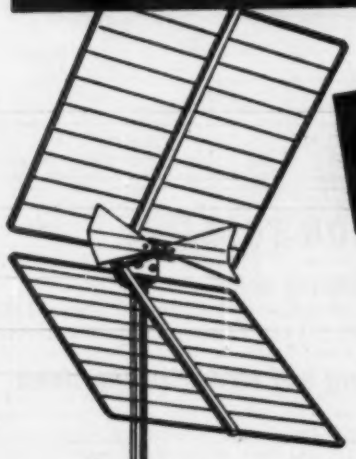

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• *more than 10,000* ***skilled tube craftsmen***

• *backed by 30 years* ***of tube engineering, development and production experience***

Raytheon's newest plant at Quincy, Massachusetts is expressly designed to economically manufacture 24 inch and larger Raytheon Picture Tubes. It will employ the very last word in modern engineering and manufacturing techniques. It will be devoted exclusively to the making of tubes worthy of the Raytheon reputation for quality and dependability.

With *Raytheon* Radio and Television Tubes you are *Right* . . . for *Sound* and *Sight.*

RAYTHEON®

Excellence in Electronics

RAYTHEON MANUFACTURING COMPANY

Receiving Tube Division

Newton, Mass., Chicago, Ill., Atlanta, Ga., Los Angeles, Calif.

RAYTHEON MAKES ALL THESE:

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ADVANCE! Raise your earning power—learn RADIO-TELEVISION-ELECTRONICS by SHOP-METHOD HOME TRAINING

GOOD JOBS AWAIT THE TRAINED RADIO-TV TECHNICIAN

There is a place for *you* in the great Radio-Television-Electronics industry when you are trained as National Schools will train you at home!

Trained technicians are in growing demand at good pay—in manufacturing, broadcasting, television, communications, radar, research laboratories, home Radio-TV service, and other branches of the field. National Schools Master Shop-Method Home Training, with newly added lessons and equipment, trains you in your spare time, right in your own home, for these fascinating opportunities. OUR METHOD IS PROVED BY THE SUCCESS OF NATIONAL SCHOOLS TRAINED MEN, ALL OVER THE WORLD, SINCE 1905.

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Many National students pay for all or part of their training with spare time earnings. We'll show you how you can do the same! Early in your training, you receive "Spare-time Work" Lessons which will enable you to earn extra money servicing neighbors' and friends' Radio and Television receivers, appliances, etc.

MASTER ALL PHASES!

Get Master Shop-Method Home Training from an Established Practical Resident School with its own Training Shops, Laboratories, Studios — almost 50 Years of Successful Experience in Training Ambitious Men.

We Bring National Schools To You!

Superheterodyne Receiver

T.R.F. Receiver

Signal Generator

Audio Oscillator

LEARN BY DOING

You receive and keep all the modern equipment shown above, including tubes and valuable, professional quality Multitester. *No extra charges.*

FREE! RADIO-TV BOOK AND SAMPLE LESSON!

Send *today* for National Schools' new, illustrated Book of Opportunity in Radio-Television-Electronics, and an actual Sample Lesson. No cost—no obligation. Use the coupon now—we'll answer by return airmail.

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National Schools prepares you for your choice of many job opportunities. Thousands of home, portable, and auto radios are being sold daily—more than ever before. Television is sweeping the country, too. Co-axial cables are now bringing Television to more cities, towns, and farms every day! National Schools' *complete* training program qualifies you in all fields. Read this partial list of opportunities for trained technicians:

Business of Your Own • Broadcasting
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Television Manufacturing, Sales, Service
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And scores of other good jobs in many related fields.

TELEVISION TRAINING

You get a complete series of up-to-the-minute lessons covering all phases of repairing, servicing and construction. The same lesson texts used by resident students in our modern and complete Television broadcast studios, laboratories and classrooms!

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LOS ANGELES 37, CALIFORNIA • ESTABLISHED 1905
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FIND OUT NOW—MAIL COUPON TODAY!

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Mail in envelope or paste on postal card.

Send FREE Radio-TV Electronics book and FREE sample lesson. I understand no salesman will call on me.

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☐ Check here if released from service less than 4 years ago.
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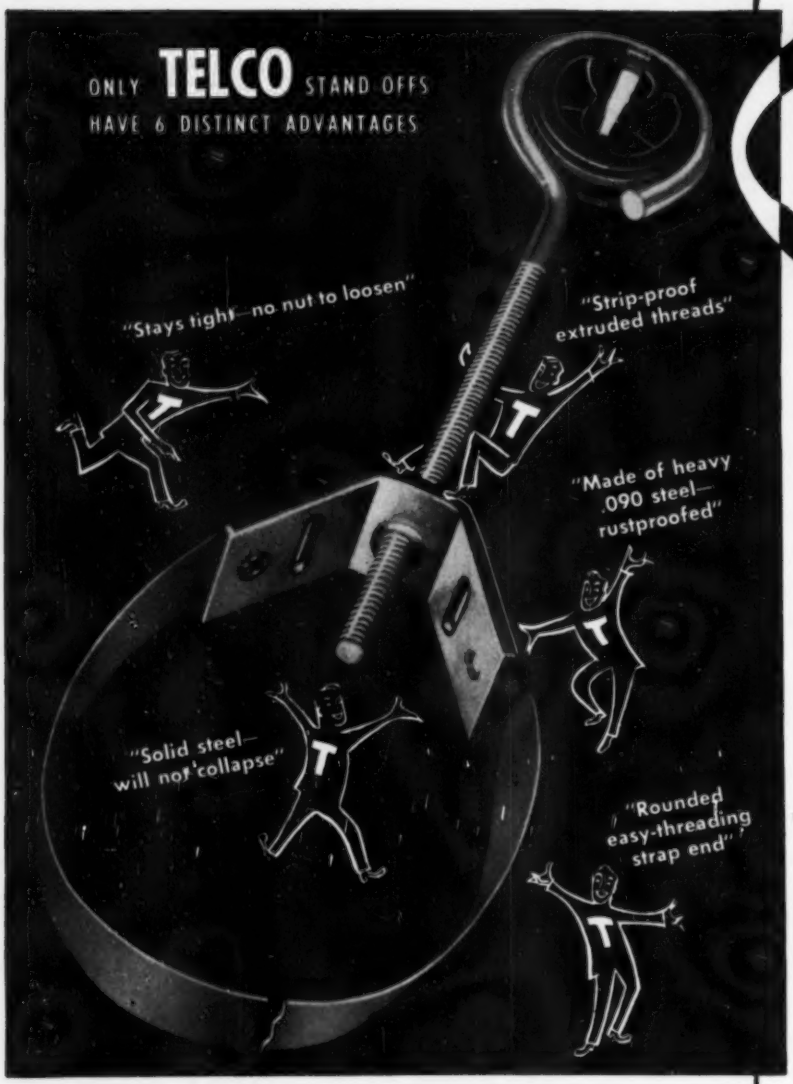
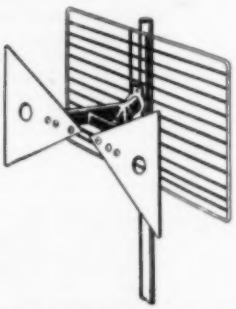
Now... One Name... One Source... for Top Quality TV Hardware!


ONLY TELCO STAND OFFS
HAVE 6 DISTINCT ADVANTAGES
"Stays tight—no nut to loosen"
"Strip-proof extruded threads"
"Made of heavy .090 steel—rustproofed"
"Solid steel—will not collapse"
"Rounded easy-threading strap end"

TELCO means Television Hardware . . . hundreds of finest quality items needed for TV installation. Here's everything you need in antenna mounts; also every type of antenna, both UHF and VHF and more real value for your money than ever before. Ask your parts distributor about TELCO . . . he's got these money-saving products.

TELCO No. 8642
UNIVERSAL UHF LIGHTNING ARRESTOR
This one arrestor fits all twin leads, mounts anywhere. UL approved. Hi-dielectric bakelite. All hardware included. List $1.25



TELCO UHF WISHBONE BUTTERFLY ANTENNA
Newest design for all-channel reception. Tested and proved best in actual UHF areas. Highly directional. Rugged aluminum construction, low wind resistance.
No. 8965 Telco Wishbone Butterfly Antenna, Single Bay with Tie Bar. List $7.75

OVER 135 MILLION TELCO STAND-OFFS NOW IN USE

- Finest Polyethylene Insert
- Smooth, Rounded Bracket Slots . . . Never Cut Strap
- 29 Telco Stand-Off Styles Available
- The Strongest Stand-Offs Ever Made

WRITE TODAY for your free copy, new TELCO Catalog

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DIVISION OF GENERAL CEMENT MANUFACTURING CO.

In capacitors, your best bet,
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SYLVAN A. WOLIN & ASSOCIATES

now get *all* TV stations UHF and VHF better

WITH THE PRECISION BUILT

VEE-D-X

Antenna Rotator

finest

IN DESIGN
IN CONSTRUCTION
IN PERFORMANCE

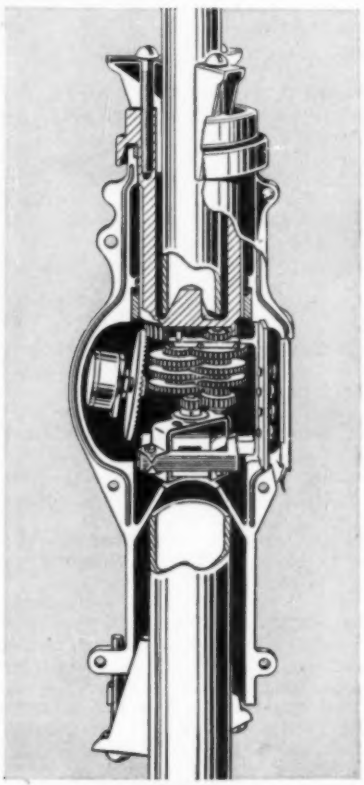
A PRODUCT OF *La Pointe* ELECTRONICS INC.
ROCKVILLE, CONNECTICUT

PREDICTION

THE VEE-D-X ROTATOR WILL SOON BE THE NATION'S BEST SELLER!

Seeing is Believing!

Study this cutaway view. See for yourself why it is truly the finest of all rotators.



THE MAGNIFICENT DECORATOR STYLED CONTROL CONSOLE

Here is the perfect companion to the finest of all rotators. The unique fingertip-action control operates with a convenient downward pressure that completely eliminates any need to hold console to prevent its sliding. It is engineered for instantaneous clockwise and counterclockwise action. Its easy-to-read dial gives both compass and numerical points. Available in two popular colors: Heather Green for light colored cabinets, Cordovan Mahogany for dark.

This forecast is not given lightly — nor do we expect it to be accepted lightly. It is backed by sound business reasoning and the awareness that VEE-D-X engineering, in collaboration with other world famous manufacturers, have jointly produced the finest of all rotators. It is so far in advance of anything on the market that a comparison with existing rotators will only serve to substantiate these (not lightly given) claims.

Many months of research, planning and testing were spent on the VEE-D-X Rotator. Its many exclusive and precision incorporated features assure pin-point accuracy and complete dependability under all weather conditions. The VEE-D-X Rotator is precision made for precision performance — designed to provide TV reception at its very best.

VEE-D-X OFFERS YOU RIGHT NOW ALL THE FEATURES YOU'VE DREAMED OF IN A FINE ROTATOR

PRECISION-BUILT—The VEE-D-X Antenna Rotator is built with the same precision with which it was engineered. Nothing has been spared in quality construction to provide the utmost in dependability and long trouble-free operation.

ADVANCED STYLING — Streamlined case design — better looking, less wind resistance.

FINEST GEARING OF ANY ROTATOR — Unique. Compact. Efficient. The self-contained, flanged spur gear train of the VEE-D-X Rotator puts it in a class by itself. Flanged reinforced gear teeth cannot be stripped. Designed and developed in cooperation with world famous small gear specialists. It provides most dependable performance under all conditions.

BALANCED MOUNTING — In-line (axial) mounting. Relieves strain on mast and guy wires. Equalized load distribution—no cumbersome offset—improved rooftop appearance.

WEATHER-RESISTANT FINISH—Entire unit is completely finished with new weather-resistant Luster-On #15 that meets rigid Army Signal Corps specifications. Stays bright—will not corrode.

FINEST MAST CLAMPS OF ANY ROTATOR — The positive three jaw chuck-type mast clamp is a VEE-D-X feature that provides simplest installation and the largest clamping surface of any rotator.

POSITIVE MAST ALIGNMENT — Is assured with built-in, self-centering mast guides both top and bottom.

FAST, EASY LINE CONNECTIONS—Accommodate four wire line. Exclusive snap-in cover, slides into place — no screws to drop when installing.

FULL 365 DEGREE TRAVERSE — Eliminates necessity of reversing rotation at critical points at end of normal 360 degree traverse.

POSITIVE ANTENNA BRAKE—No over travel, assures pin-point accuracy the moment control actuator is released.

EXTREMELY POWERFUL — Will support a load of over 200 pounds—thereby eliminating any need for the extra expense of an auxiliary thrust bearing.

GUYED AT TOP—Three guy ring lugs are cast as an integral part of the case for maximum strength. Spaced 120 degrees apart—permits three or four wire guying.

DECORATOR STYLED CONTROL CONSOLE — Smaller, more compact, more beautiful than any other. Unique control actuator. Dial gives both compass and numerical reference points. Plastic case in choice of beautiful decorator colors — Heather Green or Cordovan Mahogany.

ACCURATE COMPASS INDICATION AT ALL TIMES — No screw driver adjustment required to compensate for voltage fluctuation.

FACTORY TESTED AND GUARANTEED—Every Rotator and Control Console is thoroughly tested electrically and mechanically and fully guaranteed.

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LaPointe Electronics Inc.
Rockville, Connecticut

Mail ..... copies of Rotator literature.

Name .....

Street .....

City ..... *Zone* .... *State* .....

For sound trucks • parades
carnivals • resorts • busses
outdoor meetings

ECONOMICAL MOBILE AMPLIFIERS *by* Newcomb

MODEL E-25MP

Newcomb mobile amplifiers are carefully built for the rugged conditions of mobile use and to deliver consistently the top quality performance you expect from any Newcomb amplifier. Dollar for dollar they give you more good service, more convenient operational features and more all around, long-time satisfaction.

MODEL E-25MP delivers 25 watts from either 6 volt battery or 117 A.C. It has a standby switch, separate power and phono switches and inputs for 2 mikes and 1 phono. Heavy duty plugs. 2000 volt hermetically sealed buffer condenser. Phase correction capacitator for phono motor.

MODEL E-25M is the same amplifier without phono top.

MODEL E-10M is a rugged, low cost, 10 watt unit also for either battery or A.C. power. Has standby switch, inputs for 1 mike, 1 phono. Special mounting simplifies installation and removal.

E-10M

Send for full information today!

NEWCOMB AUDIO PRODUCTS CO.

Dept. F, 6824 Lexington Ave., Hollywood 38, Calif.

Within the INDUSTRY

HENRY F. ARGENTO has been appointed vice-president and general manager of *Raytheon Television and Radio Corporation*, Chicago subsidiary of *Raytheon Manufacturing Co.*

He has been with the company since 1932 and has most recently served as assistant vice-president and assistant manager of the company's power tube division. He entered business as a research engineer at the *Radio Frequency Laboratory* in Boonton, N. J. in 1931 and a year later joined *Raytheon* where he engaged in test work in the receiving tube division at Newton, Massachusetts.

* * *

ALLEN B. DU MONT LABORATORIES, INC. has opened a new plant for the manufacture of cathode-ray instruments for industrial and defense use. It is located at 760 Bloomfield Avenue in the Allwood section of Clifton, New Jersey . . . **GENERAL INSTRUMENT CORPORATION** has acquired a fourth plant in its current expansion program. The new facility is located in Danielson, Conn. and will be used for assembly work . . . **U.S. WIRE & CABLE CORP.** has moved into a modern plant at Progress Avenue and Monroe Street in Union, N. J. The new plant will permit the firm to triple its production of all types of wire for radio, television, and electronics . . . **THE POLARAD ELECTRONICS CORP.** has acquired 20,000 square feet of manufacturing space in a newly constructed building at 2 Franklin Ave., Brooklyn, N. Y. Research and development activities as well as production line facilities can be accommodated at the new location . . . **PIONEER ELECTRONICS CORP.** of Santa Monica is building a new plant for the manufacture of television picture tubes. The new factory will have 30,000 square feet of enclosed space and 20,000 square feet of paved ground for parking, loading, and potential expansion . . . **ALPRODCO, INC.** of Dublin, Georgia has announced plans for the construction of a new building. The new structure will have 10,000 square feet of floor space . . . **EMERSON RADIO AND PHONOGRAPH CORPORATION** has taken title to the ten-story building located at 524 West 23rd Street, New York City. It will be used as administrative and engineering headquarters for the radio and television firm . . . **RADIO CITY PRODUCTS CO.** has leased a 2½ acre tract of land at Easton, Pa. and will erect a new one-story manufacturing plant to adjoin their present production center. An additional 13,000 square feet of production area will thus be available . . . **WESTINGHOUSE ELECTRIC CORP.** has dedicated two new tube plants, in Elmira and Bath, New York. The Elmira plant produces TV picture tubes, power tubes for transmitters and electronic devices, and x-ray tubes. The Bath plant is making some 60 types of small receiving tubes . . . **ROHN MANUFACTURING CO.**, tower and tower accessory maker, has a new mailing address—116 Limestone, Bellevue, Peoria, Illinois.

* * *

HARRY C. CRAWFORD has been elected president of *Radiart Corporation*, replacing L. K. Wildberg in the post.

Mr. Crawford has been associated with *Cornell-Dubilier* and *Radiart* for the past eight years as works manager as well as comptroller and assistant treasurer for both the affiliated firms.

Before joining *C-D* and its subsidiary he was an industrial engineer with *Douglas Aircraft* and spent five years as vice-president and sales manager of *International Piston Ring Co.*, joining that firm from *Thompson Products* where he served twenty years as business manager of the automotive parts replacement division. He will make his headquarters in Cleveland.

* * *

CAMPBELL RUTLEDGE, JR. has been named to the newly-created post of assistant general manager of the electrical products division of *Corning Glass Works*, and **FORREST E. BEHM, JR.** is the new manager of the division's Pressware Plant which produces television bulbs . . . **JOHN F. QUIRK** has assumed the duties of director of purchases for the five outlets of *Federated Purchaser, Inc.* . . . *General Precision Laboratory, Inc.* has appointed **NATHANIEL M. MARSHALL** manager of television equipment sales. He has been with the firm since 1950 . . . **C. KENNETH HERSEY** is the new sales manager of the downtown sound department of *Hudson Radio & Television Corp.* of New York City. He will make his headquarters at 212 Fulton Street . . . **THOMPSON H. MITCHELL** has been elected president of *RCA Communications, Inc.*, succeeding **H. C. INGLES** who retired recently . . . **JEROME M. HOLLANDER**, formerly associated with *Allen B. Du Mont Laboratories, Inc.*, has been appointed senior engineer of *Radio City Products Com-*

GET MORE!

LEARN MORE!

EARN MORE!

THOUSANDS OF NEW JOBS IN TELEVISION

I PREPARE YOU AT HOME IN YOUR SPARE TIME

Leonard C. Lane, B.S., M.A.
President of Radio-Television Training Association. Exec. Dir. of Pierce School of Radio and Television.

I GIVE YOU *MORE* EQUIPMENT TO TRAIN YOU BETTER

Set up your own home laboratory with the 15 BIG TV-Radio kits we send you. You build AND KEEP your own complete BIG SCREEN TV RECEIVER, Super-Het Radio Receiver, R.F. Signal Generator, Combination Voltmeter-Ammeter-Ohmmeter, C-W Telephone Receiver, AC-DC Power Supply. Everything is furnished complete, including all tubes, plus big TV picture tube.

MORE TRAINING TO FIT YOU FOR THE BETTER PAY JOBS

Thousands of new jobs will open up right in your own state, now that the government has lifted restrictions on new TV stations. My simple, successful methods have helped hundreds of men — most of them with NO PREVIOUS TRAINING — find places in America's booming TELEVISION and Electronics industries. You too can get the success and happiness you always wanted out of life within months . . . studying at home . . . as I train you to become a full-fledged TV TECHNICIAN. Many of my students make as much as $25.00 a week repairing Radio-TV sets in their spare time while learning . . . pay their entire training almost from the very beginning from spare time earnings . . . start their own profitable service business.

But I don't stop after I qualify you as a TV Technician . . . although right there you can choose from among dozens of fascinating careers! I continue to train you — AT NO EXTRA COST — to qualify for even better pay in the BETTER JOBS that demand FCC licenses, with my . . .

MORE VALUE!

YOU GET A ROUND TRIP TO NEW YORK CITY AT NO EXTRA COST

FROM ANYWHERE IN THE U.S. OR CANADA — I pay your way to New York and return, PLUS 2 FREE weeks, 50 hours of advanced instruction and shop training at the PIERCE SCHOOL OF RADIO & TELEVISION. You use modern electronics equipment, including student-operated TV and Radio stations. You go behind the scenes of New York's big Radio-TV centers, to study first hand. And I give you all this AT NO EXTRA COST! (Applies to complete Radio-TV course only.)

Only RTTA makes this amazing offer.

I GET MY GRADUATES GOOD PAYING JOBS

"Thanks to your training, I qualified for a good job as a Receiver Tester at Federal Telephone and Radio."
— Paul Frank Seier

"I'm making good money in my own business, repairing and installing radio and TV sets — thanks to your training."
— Irwin Polansky

"Your excellent instruction helped me get my present job as an airport radio mechanic for American Airlines. — Eugene E. Basko

"I'll always be grateful to your training which helped me get my present fine position as Assistant Parts Manager."
— Norman Weston

Many others working at NBC, RCA, CBS, DuMont, Philco, Emerson, Admiral and other leading firms.

FREE FCC COACHING COURSE

PREPARES YOU AT HOME FOR YOUR FCC LICENSE.
THE BEST JOBS IN TV AND RADIO REQUIRE AN FCC LICENSE.
Given at NO EXTRA COST after TV Theory and Practice is completed.

NOW! ADVANCED FM-TV TRAINING

If you have previous Armed Forces or civilian radio experience—my ADVANCED COURSE can save you months of training. Full theory and practical training . . . complete with kits, including BIG SCREEN TV RECEIVER and FREE FCC License Coaching Course.

FREE EMPLOYMENT ASSISTANCE

My vocational adviser will help you obtain a good-paying job in the locality of your choice.

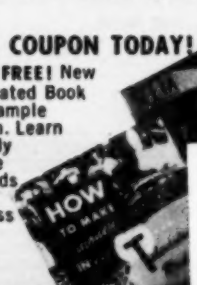
VETERANS!

MY SCHOOLS FULLY APPROVED TO TRAIN VETERANS UNDER *NEW* G.I. BILL! If discharged after June 27, 1950 — CHECK COUPON BELOW!

Also approved for RESIDENT TRAINING in New York City . . . qualifies you for full subsistence allowance up to $160 per month.

MAIL COUPON TODAY!

BOTH FREE! New Illustrated Book and Sample Lesson. Learn How My Simple Methods Make Success Easy!



NO SALESMAN WILL CALL!

Mr. Leonard C. Lane, President
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1629 Broadway, Radio City Station
New York 19, N. Y. Dept. T-6

Dear Mr. Lane: Mail me your NEW FREE BOOK and SAMPLE LESSON that will show me how I can make BIG MONEY in TELEVISION. I understand I am under no obligation and no salesman will call.

(PLEASE PRINT PLAINLY)

Name _____ Age _____

Address _____

City _____ Zone _____ State _____

I am interested in: ☐ Radio-TV ☐ Advanced FM-TV.
VETERANS: If qualified under new G.I. Bill, check your choice: ☐ Home Study ☐ Resident Study.

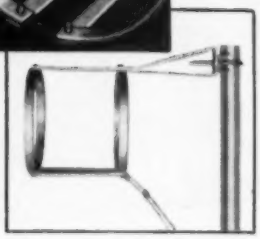
RADIO-TELEVISION TRAINING ASSOCIATION

1629 Broadway, Radio City Station, New York City 19, N. Y.
LICENSED BY THE STATE OF NEW YORK

THE *PLUS VALUE* ANTENNA *for perfect* ULTRA VISION TV!

Rytel

DOUBLE "O" UHF ANTENNA



UHF stations are springing up all across the country. Demand is terrific. Start right with a performance antenna that *can't* give you "customer headaches."

NOT ONLY IN PORTLAND BUT ALL OVER THE COUNTRY THE DOUBLE-O CONSISTENTLY GIVES THE BEST PERFORMANCE. Thousands in use in Arkansas, Maine, Massachusetts, New Jersey, Wisconsin, Pennsylvania—and all other UHF areas. The Best Performer PLUS

SIMPLICITY . . . NO ELECTRICAL OR MECHANICAL BREAKDOWNS

PLUS **ECONOMY**... simple, tough aluminum construction means low price, no maintenance, long life.

PLUS **RUGGED CONSTRUCTION**... simplicity of design avoids fragile, expensive insulators, no chance of electrical or mechanical breakdown. Supported at current node (ground potential).

PLUS **APPEARANCE**...no more monstrosities on the roof...just simple, attractive...perfect Double-O.

PLUS **INSTALLATION**... no more "servicemen's nightmares"... Double-O is a serviceman's dream...comes completely assembled, just a "U" clamp to tighten, no "adjustments."

It's the DOUBLE-O for PERFECT ULTRA VISION . . . ACT NOW AND BE READY WITH A UHF ANTENNA THAT NEEDS TO BE SOLD JUST ONCE.

List Price $3.49

Rytel

RYTEL ELECTRONICS MFG. CO.
9820 Irwin Avenue • Inglewood, California

Also connector clips, impedance matches, tube reactivators, tube-pullers, etc. Over 800 Rytel distributors in the United States. Write for further information.

Represented in Canada by:
NORRIS BURGESS CO.
571 Yonge St., Toronto, Canada

pany . . . Littelfuse, Inc. of Chicago has named **H. A. TRIPLETT** research director for the firm . . . **DONALD A. STEWART** is the new distribution manager for the television transmitter division of *Allen B. Du Mont Laboratories, Inc.*

* * *

PAUL W. TANNER is the new general sales manager of the radio and television division of *Arvin Industries, Inc.*

He succeeds Raymond P. Spellman who has requested a less demanding assignment because of a recent serious illness. Mr. Spellman's new duties will enable him to contribute from his long experience and wide acquaintance to the company's sales and marketing problems.

The new sales manager is a twenty-year veteran with the company, having joined *Arvin* upon his graduation from Indiana University in 1933. Since 1949 Mr. Tanner has served as merchandising manager of the radio and TV division of the company.

* * *

GENERAL ELECTRIC COMPANY has changed the name of its receiver department to the radio and television department as being more descriptive of the nature of the work being done . . . **ACCURATE ELECTRONICS CORP.**, 1312 Ontario Street, Cleveland 13, Ohio has been formed to manufacture components for original equipment and jobbers in the radio, television, and electronic industry. Jos. F. Seybold, formerly product design engineer for **RADIART CORP.**, is the organizer and president of the new firm . . . **FREED RADIO CORPORATION** has changed its corporate name to **FREED ELECTRONICS AND CONTROLS CORPORATION.** The new name more nearly reflects the scope of the company's business, hence the change . . . **UNIFORM TUBES** of Collegeville 2, Pa., has been incorporated and will henceforth be known as **UNIFORM TUBES, INC.** Albert H. Mainwaring is president and chairman of the board . . . **BRENNA & BROWNE,** a manufacturers' representative firm with headquarters in Honolulu, has been formed by Dr. Burton Browne, head of *Burton Browne Advertising*, and Lennie Brenna. Mr. Brenna is an engineering graduate of the University of Minnesota and well-known in Hawaii. He will head the Honolulu operation. Dr. Brown will handle the stateside affairs of the firm from his office at 619 N. Michigan, Chicago.

* * *

RTMA reports that total television and radio set production for 1952 was valued at nearly $1.3 billion at the factory level. The manufacturers' value of all radio-TV receivers produced during the year was estimated as $1,298,847,000 by the Association.

The 1952 dollar volume was based on an estimated production of 6,096,279

(*Continued on page* 159)

Sweeping the Country!

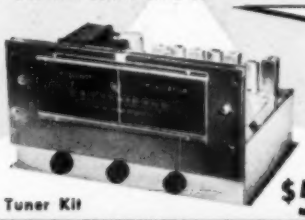
BUY DIRECT AND SAVE

'PRE-FAB' **COLLINS** TUNERS and RECEIVERS

AUDIO PRODUCTS CO.

Collins Audio Products Co. is in no way affiliated with Collins Radio Co.

Two ALL NEW Complete Kits for Every High-Fidelity Need



FM Tuner Kit **$55**

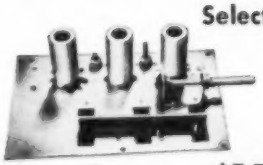
The FM-11 tuner is available in kit form with the IF Amplifier mounted in the chassis, wired and tested by us. You mount the completed RF Tuning Unit and power supply, then after some simple wiring, it's all set to operate. 11 tubes: 6J6 RF amp, 6AG5 converter, 6C4 oscillator, 6BA6 1st IF, (2) 6AU6 2nd and 3rd IF, (2) 6AU6 limiters, 6AL5 discriminator, 6AL7-GT double tuning eye, 5Y3-GT rectifier. Sensitivity 6 to 10 microvolts, less than ½ of 1% distortion, 20 to 20,000 cycle response with 2DB variation. Chassis dimensions: 12½" wide, 8" deep, 7" high. Illustrated manual supplied. Shipping weight 14 lbs.

Each Collins Tuner Kit is complete with punched chassis, tubes, power transformer, power supply components, hardware, dial assembly, tuning eye, knobs, wire, etc., as well as the **completed** sub-assemblies: FM tuning units, AM tuning units, IF amplifiers, etc., where applicable. Since all these sub-assemblies are wired, tested and aligned at the factory, Collins Pre-Fab Kits are easily assembled even without technical knowledge. The end result is a fine, high quality, high fidelity instrument at often **less than half the cost** — because you helped make it and bought it direct from the factory. Bring your present reproducing system up to date with a new Collins Tuner.

FM/AM Tuner Kit **$77.50**

The original 15 tube deluxe FM-AM pre-fab kit redesigned on a smaller chassis. The tuner now measures 14" wide by 12" deep by 7½" high. This attractive new front and dial assembly opens up new applications where space is at a premium. Kit includes everything necessary to put it into operation—punched chassis, tubes, wired and aligned components, power supply, hardware, etc. Kit comprises FMF-3 tuning unit, IF-6 amplifier, AM-4 AM tuning unit, magic eye assembly and complete instructions. All tubes included. Shipping weight 19 lbs.

Selected Basic Components For Special Applications



FMF-3 Tuning Unit **$15.25**

The best for FM. The most sensitive and most selective type of "front end" on the market. 6 to 10 microvolts sensitivity. Image ratio 500 to 1. 6J6 tuned RF stage, 6AG5 converter, 6C4 oscillator. Permeability tuned, stable and drift-free. Chassis plate measures 6½"x4½". In combination with the IF-6 amplifier, the highest order of sensitivity on FM can be attained. Tubes included as well as schematic and instructions. Draws 30 ma. Shipping weight FMF-3: 2½ lbs. Dial available @ $3.85

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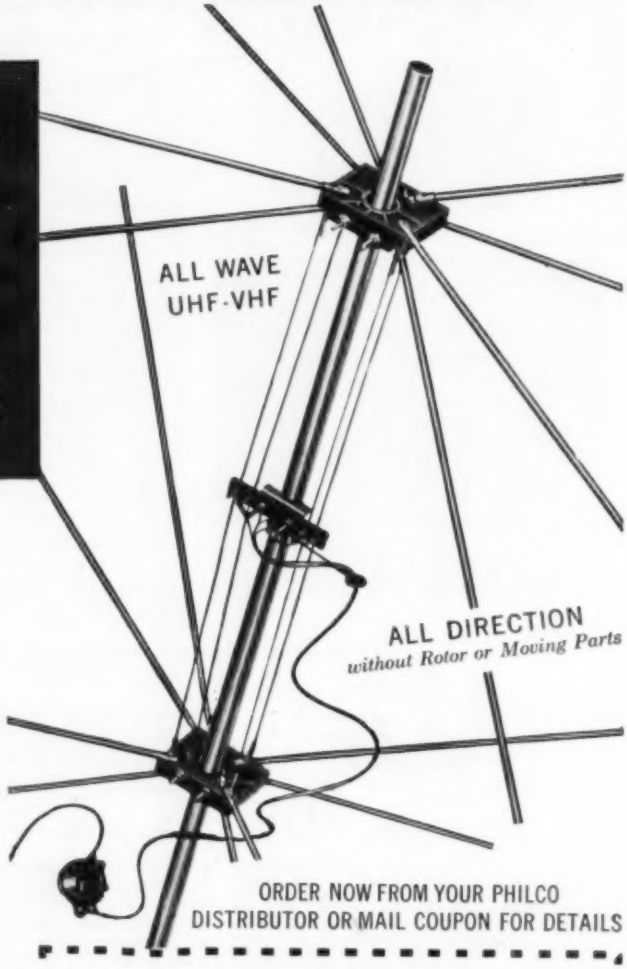

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Single Array		7.8	14.0	6.7	-1.7	16.3	2.5	6.0	9.6	12.1	10.8	15.0	12.8
Gain Chart	36"	18.8	3.5	7.4	17.3	0.0	-1.3	6.0	8.4	11.5	13.0	12.5	13.0
using	45"	6.5	14.3	6.0	-6.0	18.6	6.7	8.5	18.2	18.1	13.2	14.3	14.5
different	60"	5.8	2.2	9.6	-1.0	-2.0	1.5	-4.0	10.3	4.0	15.4	7.0	15.5
spacing	82"	8.4	15.5	13.0	10.5	21.3	3.0	14.0	-2.0	1.6	10.0	6.0	6.0
between	98"	2.5	8.0	9.5	-4.5	17.0	6.0	2.0	4.0	1.0	10.0	7.0	3.7
two single	114"	21.0	19.0	7.4	22.3	0.0	6.0	8.2	10.4	11.5	14.0	14.1	14.3
arrays	122"	7.4	17.0	13.4	2.5	21.5	8.5	17.3	16.2	12.1	14.8	15.6	10.5

The above tests were made using a 40-foot lead-in. However amazing results have been obtained on installations using a lead-in up to 150 feet without any appreciable difference in gain. These tests were made in real fringe areas.

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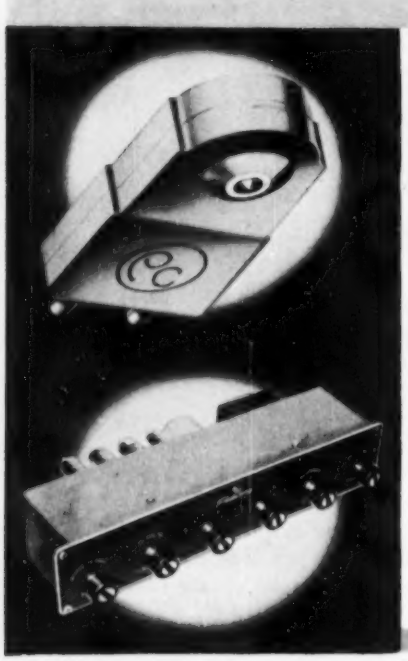

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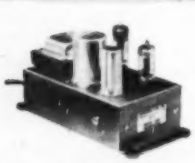
MODEL 410 AUDIO INPUT SYSTEM . . .

is designed to provide a complete audio control center. Model 410 may be used in any high quality playback system. Three input channels are provided—one for magnetic cartridges and 2 "flat" channels for other audio circuits. A 3-position equalizer network is built into the magnetic cartridge channel and provides accurate equalization for LP, AES and 78 rpm recording characteristics. Separate bass and treble controls are also provided. These are of the step-type and permit bass and treble adjustments in 2 db increments. The tone control circuits are intended to compensate for record characteristics and for listener-environment acoustical conditions. *They are not intended to compensate for amplifier and/or loudspeaker deficiencies.* Model 410 is intended for use with the highest quality professional type playback equipment. The output of the Model 410 is fed from a cathode-follower circuit and will work into any high quality audio or line amplifier having a high impedance input. It may also be used with a transformer for the purpose of feeding a 500 ohm line. Because of its flexibility, low noise and low distortion level, it is ideally suited for bridging and monitoring purposes and for critical listening applications.

THE MODEL 190 ARM . . .

is designed primarily for use with microgroove records. Its design has been recognized by leading audio engineers as that which incorporates all of the desirable tracking characteristics. Analysis has shown that for maximum performance with LP records the vertical mass of the moving arm element must be held to a minimum and further, that the arm must be counterbalanced about the vertical axis. This permits minimum stylus or tracking force and provides maximum record life. The Model 190 Arm embodies these all important features necessary for proper microgroove record playback.



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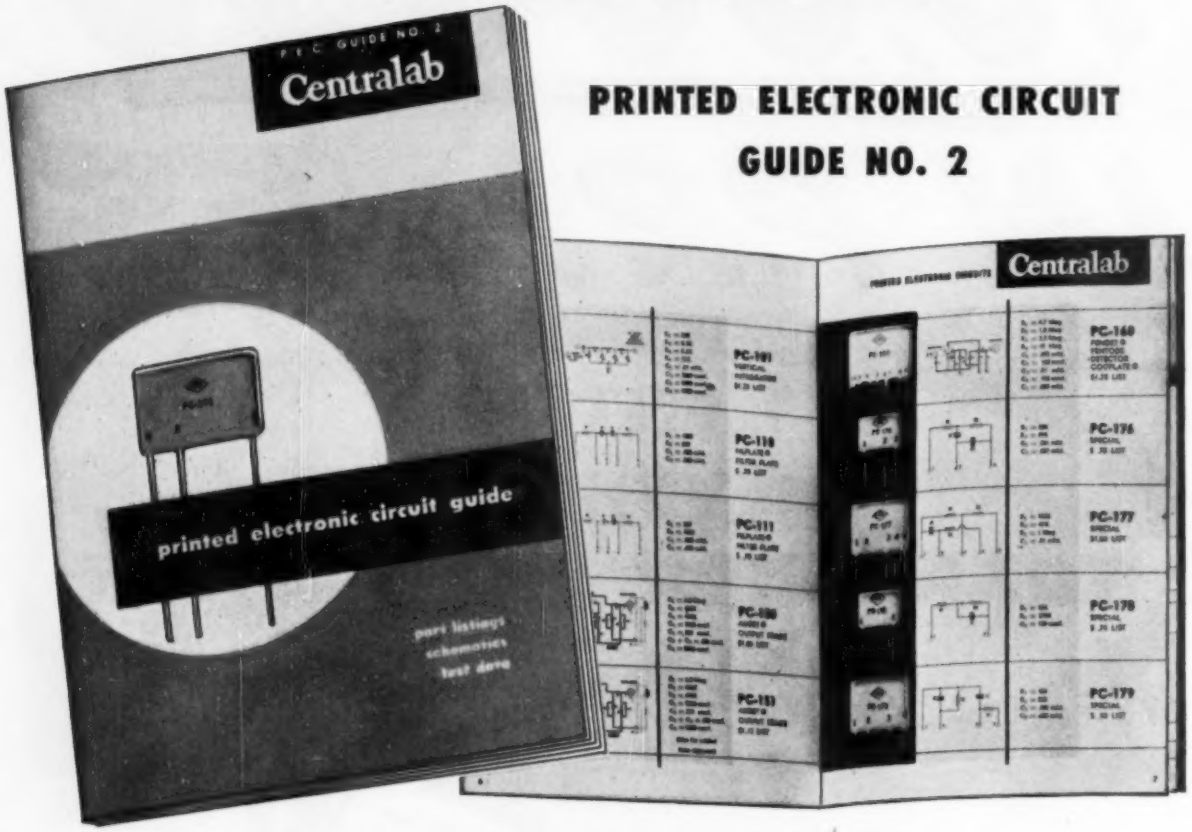

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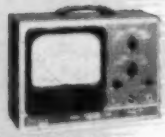

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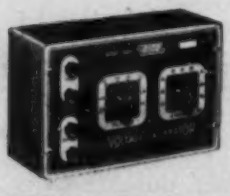

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VHF COMMUNICATIONS IN KOREA

By 1st Lt. RICHARD G. GOULD
Asst. Radio Officer, Eighth U. S. Army, Korea

The author checks circuits at the 58th radio relay station, somewhere in Korea.

An ingenious radio relay system is saving time, money, and equipment for our troops.

A MAJOR entered the tent of the Division Commander waving a mud-spattered piece of paper. "The Chinese" he read, "have the regiment surrounded, General. There's no wire communication left between our headquarters and theirs." The General reached for the field phone on his desk. "Give me ——" he said, using the telephone code name of the regiment. Within seconds he was talking to the regimental commander. He spoke quickly about the situation and the immediate action the reserve unit was taking. He outlined his orders for the trapped regiment and hung up after receiving assurance from the regimental commander that they could make the plan work. Not long thereafter the regiment was reunited with the division and was fighting again as an effective part of our forces in Korea.

This quick, personal call between the two commanders, and the other vital messages that followed, directing artillery, guiding air support, and controlling troop movements actually took place during the big pull-back of the Eighth Army after the Chinese intervention in Korea. Without the use of v.h.f. radio relay equipment, these calls would have been impossible. Without these calls the General and his staff would have had to rely on tactical high frequency radio equipment. They would not, though, have been able to give the detailed instructions, or told exactly what they wanted done and received the immediate response possible only over a direct telephone circuit. Just as a picture is worth a thousand words, a personal conversation is worth a hundred written messages.

Since the first days of the Korean campaign, very-high-frequency radio relay equipment has been one of the mainstays of the UN communications network. Now under the direction of Brigadier General Wesley T. Guest, Eighth Army Signal Officer, the v.h.f. network blankets Korea from the Peace Camp at Munsan-ni to the Prisoner of War camps on Cheju Island. At this time there is even one infantry division operating v.h.f. down to a forward observation post overlooking the enemy lines. Chinese mortar and artillery fire kept chopping all the wire circuits as quickly as they were installed; v.h.f., however, provided telephone circuits without wire. To install this system the v.h.f. equipment was mounted in a bunker with the carrier equipment lying on its back nearby. The standard antennas are also inside, pointing out of holes just a little wider than the arrays. This system has been so reliable that units slightly to the rear actually run their lines forward to this bunker to get circuits back to

Sgt. Kenneth Harman, station chief, v.h.f. site, Korea, changes a tube while the author, in background, oversees the operation.

Jeep-mounted v.h.f. terminal equipment. Telephone contact with any unit in Korea is possible with this particular installation.

Sgt. James C. Cooper, station chief, v.h.f. site in Korea, repairs a transmitter at the 581st signal relay co. station.

Pfc. Phillip Tesone, v.h.f. radioman in Korea, makes adjustments on a transmitter at the 556th signal radio relay site.

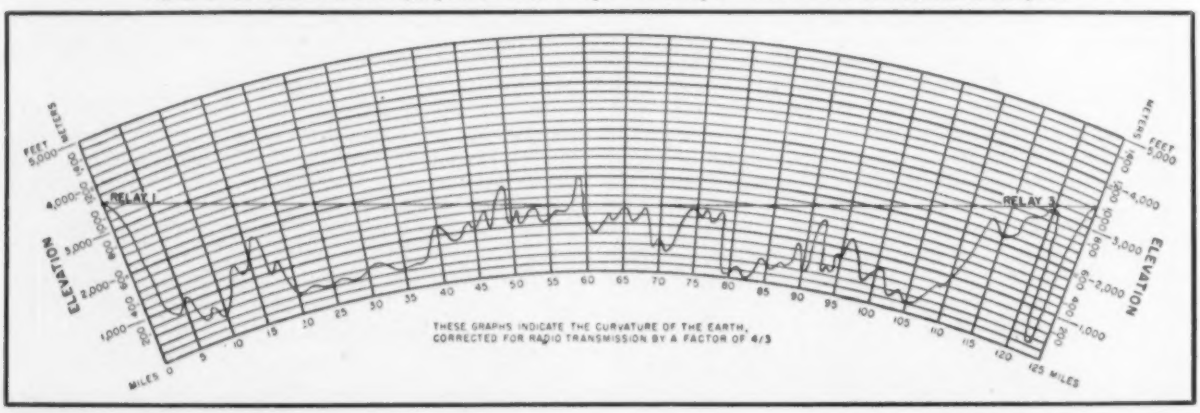
higher headquarters. A near miss on the bunker showered rocks and dirt on the equipment without causing a minute's outage.

From the very beginning of the Korean campaign the units operating v.h.f. equipment have been hampered by the same factors that affect all the operations of an army in the field. To the usual problems of shortages of equipment, lack of sufficiently trained personnel, and the eternal requirement for getting the job done "yesterday," the rugged peninsula of Korea has added worries. The terrain was, at first, a severe limitation on the use of v.h.f. systems. This equipment, known as the AN/TRC 3 and 4, transmits a frequency modulated signal in the 70 to 100 megacycle band. According to conventional propagation theory, transmission in this frequency range is supposed to be "line-of-sight" with only a slight bending effect beyond the optical horizon.

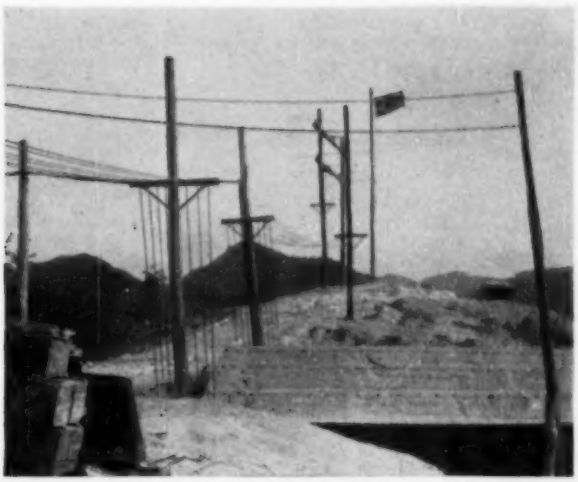
The technical manual for the equipment states that distance between relay stations should be limited to under 30 miles to maintain a high signal-to-noise ratio. If these restrictions held fast, few of the existing v.h.f. systems in Korea could have ever been installed. On most of the peninsula, rugged mountains bring the horizon "into your backyard." Overcoming this limitation meant that the v.h.f. stations had to be located atop these mountains. Once on the peaks, the "hop" lengths rose from 30 miles to 70, 80, and 90 miles, far surpassing the ranges possible with 40-foot antennas on level ground. Without such distances, the Signal Corps could not have supplied the radio relay systems to link the Eighth Army with its Corps, using equipment on hand, during the 300-mile long drive which took the UN from the Pusan Perimeter to the Yalu River. There simply was not enough equipment or personnel to install and operate relay stations every 30 miles. In addition, due to cumulative tube and set noise, the quality and readability of circuits decreases as additional relays are placed in the system. Extending the lengths of individual transmission paths resulted in better circuits.

At Army level the main problem was distance: at Division level it was speed. It can take up to three days to install a station on a mountain top and the division teams could not afford this delay at a time when their headquarters would be moving every four or five days. Their solution in many cases, was to direct the transmitted beam to a distant mountain so that it would be reflected to the far terminal beyond the actual line-of-sight. Many times the direction of advance was up long river valleys. In these cases the beam would be directed slightly towards one side of the valley and it would be reflected from side-to-side as it faithfully followed the winding valley to the distant terminal. Receiving tests were later conducted to determine if this "bouncing" was actually taking place. A receiver mounted in a truck indicated that every few miles it would "pass through the beam" as the truck was driven down a road through the valley. Many times at the distant terminal it was noticed that moving the antennas laterally as little as a few hundred feet caused the received signal strength to drop 75 per-cent. This situation can be compared to a rudimentary wave guide operating at a lower frequency than conventional fabricated guides. The dead spots in the receiver tests were caused by non-parallel "guide"

Fig. 1. Profile chart of line-of-sight path between Relay 1 and Relay 3. Note the two obstructions in this path.



View of one of the cloud-topping relay stations. Korean guards, operating personnel, and antennas are visible among the boulders.



A v.h.f. terminal station. Coaxial cables are laid to separate transmitting and receiving fields. Poles carry the cables.

walls and gaps in the line of mountains on both sides of the valley.

Recently even transmission distances of 90 miles have been exceeded. The 8189th Signal Service Battalion that operates all the v.h.f. systems for the Eighth Army had several systems between Seoul and Taegu which utilized three relay stations. These stations were all well over 3000 feet in height and air-line distances between them averaged 65 miles. It was decided to eliminate the middle relay leaving a 126-mile span between relays one and three.

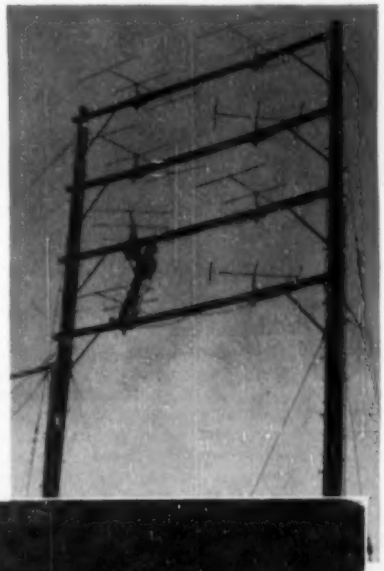
As the first step, a profile chart was run assuming line-of-sight transmission. The accepted figure for the earth's radius of four thirds the actual one was used on this profile to account for the "bending" that takes place beyond the horizon. This chart (Fig. 1) showed two masks directly in the path of the beam. One is 400 feet high and the other 600 feet. Antennas at each site were oriented with a compass to point towards the distant station as determined from maps of the area. The sets were turned on, and on only ten watts of final power to the three-element yagi arrays, the limiter stages of the distant receiver were saturated. This meant that all amplitude variations on the incoming signal were eliminated and a noise-free system would result.

These test shots were operated for a period of two weeks to determine if fading would occur at certain times of the day or if there was a fade cycle over a period of several days. Even a severe thunderstorm during this period, which caused interference to high frequency radio circuits did not affect the received signal strength. The pattern of received signal *vs* antenna orientation is shown in Fig. 2.

To obtain this curve the transmitting antenna at the distant station was rotated through 360 degrees and the value of grid current in the first limiter stage of the receiver was recorded. Thus the current value is proportional to signal strength since no limiting action has yet taken place. These current readings have been reduced to relative values. The zero degree point was chosen as the azimuth of the distant station as determined from a map. The difference between the right and left hand lobes is explained on the basis of the inherent unbalance of the array, one side of the dipole being grounded as are all the parasitic elements. This curve agrees closely with the theoretical curve for this type of antenna. The lack of sharply defined minor lobes is due to lack of accuracy in the metering stage and also to "residual" carriers from other transmitters on the same and adjacent frequencies operating at the same time. The curve of signal strength taken with the transmitting antenna stationary and the receiving antenna rotated is similar. This curve indicates that the beam is following

★

Repairing a receiving antenna at the v.h.f. antenna site somewhere in Korea. This is a 581st radio relay co. station.



★

Lonely Korean guard sits by his machine gun overlooking the antenna field of a v.h.f. relay station somewhere in Korea.

Pfc. Lawrence R. Jackson and Sgt. Gorver W. Potter, radiomen, switch receiving antennas at a v.h.f. relay station site.

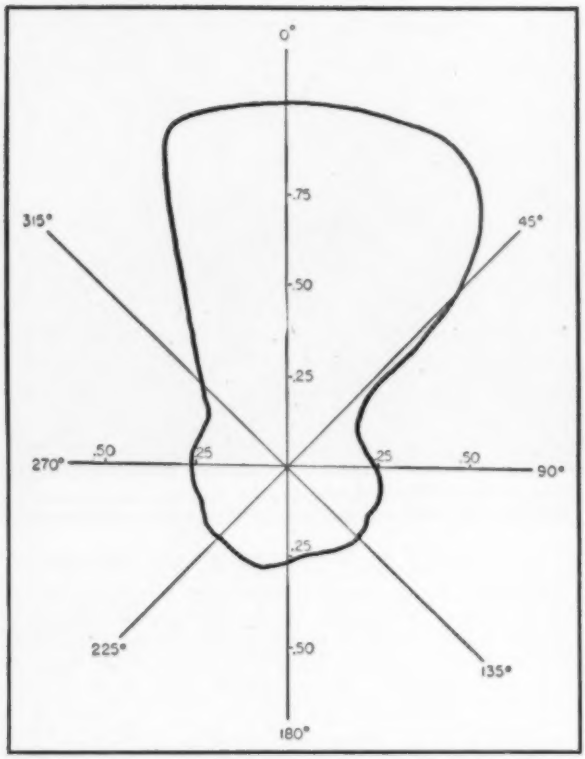


Fig. 2. Signal strength at Relay 3. See text for full details. These directive patterns are taken for each antenna location.

a direct path and that very little energy is reaching the receiver through reflected paths. The "shot" was then incorporated into the operating systems and it was discovered that, not only were the systems quiet, but quality was improved due to the elimination of the one relay. Outage time dropped markedly due to the fact that there was less equipment in the system subject to failure and that troubleshooting procedures were simplified since there were only two relay stations to coordinate while isolating a specific trouble. These systems have been in operation for over five months with less than 3% outage: twenty-four hours a day, seven days a week, through winter storms, driving mountain rains, and a series of typhoons with winds up to 65 miles an hour.

The next attempt at extended range involved shooting between two peaks, each over 3000 feet high and separated by 170 air-line miles.

The profile chart for this shot passes through a mask 2400 feet high and 57 miles deep as shown in Figure 3. Even if the earth were a perfect sphere the wave would hit the earth's surface during its path. Nevertheless, signal strengths received at both stations showed the circuit to be satisfactory using fifty watts final power and the system was established. Rotation of antennas gave essentially the same curve as the 126-mile "shot." See Figure 2. This path too, stood up day and night through the weeks that it was needed. (In this case the men operating the station not only had to keep their equipment on the air but had to work with their weapons handy in case of guerrilla attack. The guerrillas eventually did attack the guards assigned to help defend the station but were driven off after a small-arms battle.) Since this 170-mile shot also had a pattern of received signal similar to Figure 2, it indicated a straight line transmission path with no alternate reflection paths. In this case the receiver, although located on a high peak, was still far below the horizon and far beyond the range expected using the conventional formula for bending effect.

Additional inconsistencies have appeared during the months in Korea: Since there are many more transmitters operating in Korea than there are frequency assignments for the equipment, there may be three and

(*Continued on page* 151)

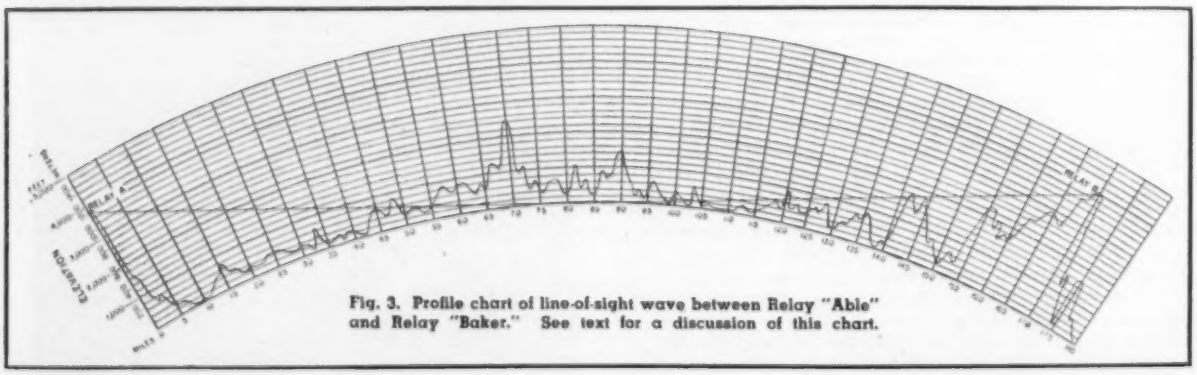


Fig. 3. Profile chart of line-of-sight wave between Relay "Able" and Relay "Baker." See text for a discussion of this chart.

USING A TRANSISTOR TO INCREASE RELAY SENSITIVITY

By
LOUIS E. GARNER, JR.

Fig. 1. Transistor setup for increasing relay sensitivity. Author's unit was built on Bakelite strip but may be housed in a standard Bud "Minibox" if desired.

Increase the sensitivity of relays and widen their application by using this simple transistor circuit.

THE experimenter will occasionally require a relay with contacts capable of handling an ampere or more current at 117 volts a.c. while, at the same time, not requiring more than a fraction of a milliampere to operate. Although there are relays available that are sensitive enough to operate on only a few hundred microamperes, such relays are not only very expensive (sometimes costing two to four times as much as less sensitive relays), but, for the most part, their current handling capacity is small.

Often, the electronics worker is forced to use *two* relays in such circumstances—a very sensitive relay connected to operate a less sensitive relay of greater power handling capacity. Such a procedure is not only expensive, but requires considerable space.

With the ready availability of the transistor, it is now practical to assemble an extremely sensitive relay capable of handling reasonable amounts of power, and utilizing *only one relay* of moderate sensitivity. Such an assembly is shown in Fig. 1. The schematic diagram of the circuit is shown in Fig. 2.

In some cases, the cost of the components required for the complete assembly illustrated will be less than the cost of a relay of the desired sensitivity, even with the present comparatively high cost of the transistor itself. The more sensitive relay will often not have the power handling capacity of this assembly.

The assembly shown in the illustration, using the components specified in the parts list, *will handle currents as high as 1.5 amperes* (at 117 volts a.c.), *yet requires a control current of only a fraction of a milliampere*, that is, only a few hundred microamperes. (From 0.2 to 0.4 ma. control current is required, depending on the adjustment of the relay.)

Circuit Description

The operation of the basic circuit depends on the fact that the transistor may be used as a simple "current amplifier."

Referring to the schematic diagram of Fig. 2, a relay of moderate sensitivity is connected in the emitter-collector circuit, together with a source of voltage, B_2. The base-emitter circuit is used for control purposes, with B_1 acting as a "bias" voltage and resistor R_1 as a current limiting resistor (to prevent damaging the transistor).

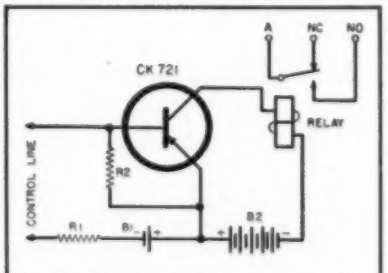
R_2 is the "base return" resistor.

Under "normal" conditions, with the *control line* open, there is no base current flow and the collector current flow is negligible. For practical purposes, the collector current flow may be considered as "zero" in this case.

When the *control line* is closed, a small base current may flow, depending upon the resistance of the line, the values of R_1 and R_2 (Fig. 2), and the bias voltage, B_1. Generally, this base current flow will be on the order of a few hundred microamperes (it should not exceed 500 microamperes). This base current flow permits collector current to flow, with an amplification of approximately ten. Thus, a 250 microampere base current flow (0.25 ma.) permits a collector current flow of about 2.5 milliamperes—enough to operate the relay (Fig. 2).

Should the *control line* be opened again, base current will cease and the collector current will drop to its previous low value (almost zero), permitting the relay to drop out.

Fig. 2. Complete circuit diagram of unit.



R_1—3300 ohm, ½ w. carbon res. (value used in model, see text)
R_2—1000 ohm, ½ w. res.
Relay—Sensitive relay, 2500 ohm coil (Advance Type 830)
B_1—1.2 or 1.5 volt battery (Mallory RM-1000 mercury cell)
B_2—15 volt hearing-aid battery (Burgess U10)
CK721—Raytheon "p-n-p" junction-type transistor

Construction Hints

No attempt was made to miniaturize the model shown in the photograph (Fig. 1) and all parts were simply mounted on a piece of surplus Bakelite. The batteries, B_1 and B_2, are held in place by small standard brackets, found in an inexpensive hardware assortment. However, if the builder

(*Continued on page* 140)

WHY USE A CONDENSER?

By **ROB WAGNER, W6WGD**
R. F. Lab., Dalmo-Victor Co.

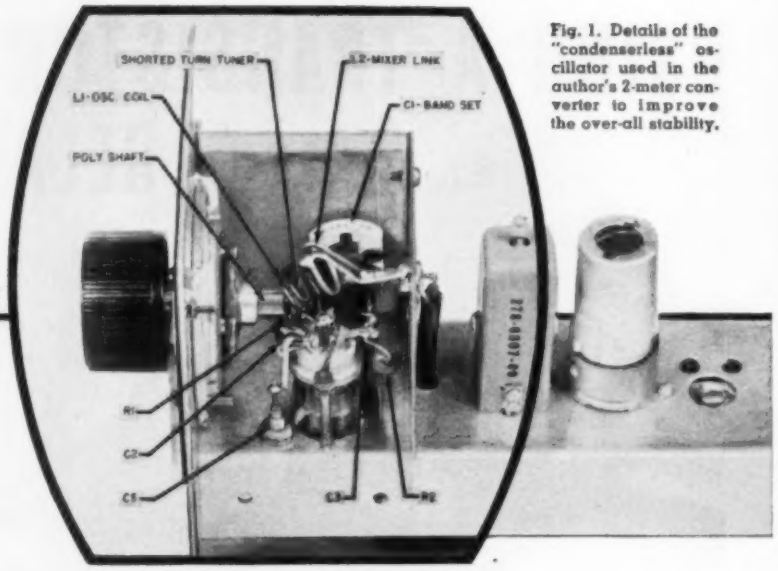


Fig. 1. Details of the "condenserless" oscillator used in the author's 2-meter converter to improve the over-all stability.

The tuning condenser in a v.h.f. oscillator is a source of headaches because of problems of stability and cost. The author cured these headaches by eliminating the condenser.

AT ONE TIME or another during the activities of the average 2-meter ham, the construction of that "red-hot" converter becomes a practical necessity. When Joe Ham listens to another amateur giving that 200-mile DX an S-9 report and Joe can't even hear the beat-note, he usually starts throwing parts into a can while heating up the iron.

In most cases, this action results in somewhat better performance than was forthcoming from the piece of war surplus machinery Joe had been using in lieu of a receiver. However, the DX may still prove elusive, due in part to high-noise r.f. stages, low conversion efficiency and, to a great extent, upon an oscillator which refuses to stay put.

Two alternatives are available: (1) To build a crystal-controlled front end which holds still but requires mixer peaking or complex broadband i.f. stages preceding the receiver, or (2) to construct a v.h.f. oscillator which is ridiculously simple, quite stable, and costs practically nothing. In order to find such a machine, the writer has dug into the deep past and come up with some determinations which should greatly assist the reader in building his new converter.

First, let's look at some advantages and disadvantages of various systems of tuning the v.h.f. oscillator. The condenser method is dandy but unhandy; a suitable v.h.f. condenser using ball-bearing shaft mountings costs more than a dollar or three and, at the present time, is almost unavailable. Its size necessitates construction which in some cases is prohibitive for mobile applications. Mechanically, the condenser-tuned oscillator must be built on the order of a Sherman tank to obtain the desired mechanical and electrical stability. To retain this stability while tuning, it is the usual practice to employ a gear reduction drive in conjunction with a vernier dial mechanism. The net result is good, providing one has the money, the time, and the mechanical ingenuity.

Instead of this costly and intricate machinery, let us appraise other methods of tuning the oscillator. A slug-tuned circuit is excellent, and combines mechanical stability with good bandspread linearity. However, a slug tuning mechanism requires that one have the equivalent of a degree in mechanical engineering in order to convert 180° of dial rotation to plus and minus one-quarter inch of linear motion! This application is presently being used in another converter, but necessitates a home brewed dial mechanism operating on the lead-screw principle, including several dial twists to cover the band and an ingenious pulley and string method of frequency indication. The slug performance is excellent electrically, but the problem still remains of attaining extreme mechanical simplicity.

What's this? An old Donald B. Duck catalogue, published at the time when 5 meters fell into the OYGWHF (*"Oh ye gods, what high frequencies!"*) category, and here is a 5-meter receiver using the ancient method of tuning an inductance with a rotating shorted turn! Similar in principle to the variometer method but using no electrical connections, this begins to look good—the shorted turn, rotating within an inductance causes a change in frequency.

Although design engineers state that this method is a "*Q*" destroyer, the writer has found empirically that a laboratory "*Q*" meter would be required to determine the losses. At the same time, an oscillator has been devised which is hard to beat from the standpoint of electrical and mechanical stability, very small size, and practically zero investment!

Note that an ultra-audion circuit is employed in Fig. 3, resulting in good electrical and mechanical symmetry; Fig. 1 shows placement of the components. A 6AB4 h.f. triode is used, so that if the tube goes bad, a 6J6 may be plugged into the socket to perform the same functions, the 6AB4 pin connections being identical with one-half of a 6J6. Acorn types were discarded for this application due to their inherent tendencies toward microphonics.

The assembly consists of a rigid front panel, suitable vernier dial, and solid subpanel, to which is firmly bolted a heavy box-shield surrounding the oscillator components. Good design practice dictates the use of heavy metal construction not only to afford electrical shielding, but to provide rigid support for other circuit parts.

The bandset condenser C_1, a 25 $\mu\mu$fd. APC-type air trimmer, is mounted upon the left side of the box shield. L_1, a two-turn, ½ inch i.d. coil, is wound of #10 copper wire, and is soldered directly to the bandset trimmer. The coil is so mounted that its linear axis forms a 45° angle with the axis of the dial shaft (see Fig. 2). A 7-pin miniature tube socket mounts upside down at the right of the dial shaft, so that grid and plate connections are as short as possible (Fig. 1). Two 82 $\mu\mu$fd. tubular ceramic condensers (C_2-C_3) serve to connect grid and plate pins to each end of the oscillator coil at

the bandset condenser. The r.f. choking function is performed by R_3, a 1000 ohm, ½-watt carbon resistor mounted between the plate pin and C_4, a 1000 $\mu\mu$fd. feedthrough condenser mounted directly beneath and beside the inverted tube. The feedthrough condenser serves as a rigid soldermount for the resistor and helps to mechanically stabilize the plate wiring. A 22,000 ohm, ½-watt carbon resistor (R_1) between the tube grid terminal and ground provides grid bias. Inasmuch as the cathode and one heater terminal are common to "B-minus," this terminal serves as tiepoint for all ground returns of the circuit. The opposite 6.3-volt heater lead is fed to the power plug through another 1000 $\mu\mu$fd. feedthrough condenser located beneath the tube socket. The mixer voltage is taken from the oscillator coil with a single-turn loop supported by a feedthrough insulator mounted above and behind the coil, Fig. 1. All that remains is the method of tuning the oscillator.

The tuner, Fig. 2, consists of a one-inch length of ¼-inch o.d. "poly" shaft (clip a few from the bottom of your ladder line) with a ¼-inch i.d. single-turn loop of solid hookup wire attached thereon at a 45° angle. In order to effect an inductance change equivalent to 4 mc. of bandspread over 180° of dial rotation, it is necessary to mount the coil at a 45° angle with respect to the axis of the tuning shaft. Since the tuning loop is also mounted upon the shaft at 45°, the plane of the loop is at a right angle to the coil axis at zero degrees of rotation; this position results in the lowest frequency reading on the dial.

At a rotation of 180°, the loop becomes parallel to the coil's lines of flux, thereby reducing the coil's inductance and resonating it at its highest frequency. A complex angle of rotation occurs during the 180° rotation, at each degree of which the inductance of the coil is varied by a correspondingly larger amount. The rate of inductance change is linear for all practical purposes. This is a major difference from older and constructionally simpler versions of the shorted turn, such as a tab or vane of copper moving across the end of a coil or between two turns. The inadequacy of these older methods kept amateurs from using the principle enough to bring out its full possibilities.

A brass washer attached to the tuning shaft comprised the first shorted-turn tuner. It was thought that bandspread could be adjusted by moving the washer closer to or farther from the end of the oscillator coil; this assumption was erroneous and resulted in a complex vectorial relationship which caused stations to repeat at various places on the tuning dial.

The washer was then placed within the coil, at its center; immediately the 2-meter band, in addition to police, aircraft, and other services were tuned over a wide frequency range, but with extreme selectivity due to lack of bandspread. It became evident that bandspread is a function of reduction of loop mass rather than one of removing the mass from the vicinity of the coil.

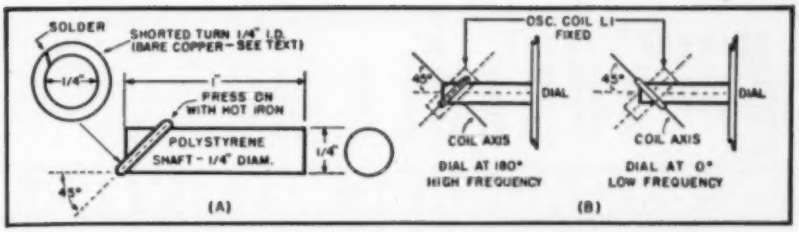
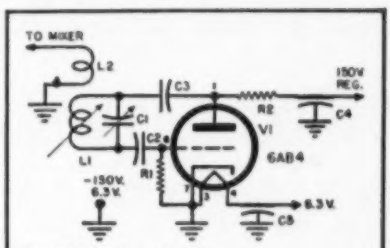


Fig. 2. (A) The heart of the "condenserless" tuning system. Several can be made up at negligible cost using wire of different sizes to get the proper degree of bandspread. "Ring" diameter (¼") should be the same for each one tried (see text). (B) Shows the relationship of the fixed oscillator coil and the movable shorted turn as the dial mechanism is turned through 180°, varying coil's inductance.

Several tuning shafts should be constructed, having a loop of different wire *size* (not loop diameter) attached thereto. In a matter of minutes, it is simple to determine the degree of bandspread by changing the entire tuning shaft and listening over the band. The bandset condenser should, of course, be trimmed so that the 2-meter band appears in the center of the dial with your particular converter i.f. The loops are rigidly attached to the shaft by pressing them into the plastic with a hot iron, using a dime-store 45° triangle as a guide, as shown in Fig. 2.

There is nothing really new in the design of this oscillator, but its application has not been used extensively in amateur circles. If the oscillator is constructed rigidly enough, one may beat upon the converter with an old binder of radio magazines with vigor, without frequency shift; stability is limited only by the mechanical construction of the oscillator tube. The linearity of the tuning depends upon the precision with which the loop and coil axes are centered, although an angular tolerance of plus or minus five degrees is acceptable. Even though the small physical size of the design makes this circuit extremely interesting to mobile operators, its functioning is so satisfactory that the writer anticipates using no other circuit at his home station. As the photographs show, it has been installed in an experimental converter in use here at W6WGD. —30—



R_1—22,000 ohm, ½ w. res.
R_2—1000 ohm, ½ w. res.
C_1—25 $\mu\mu$fd. air trimmer cond. (Hammarlund MAPC-25 or equiv.)
C_2, C_5—82 $\mu\mu$fd. tubular ceramic cond.
C_3, C_4—1000 $\mu\mu$fd feedthrough cond. (Centralab FT-1000)
L_1—2 t. #10 wire, ½" i.d. (reactance tuned—see text)
L_2—1 t. #10 wire, ½" i.d.
V_1—6AB4 tube

Fig. 3. Schematic of the "condenserless" oscillator. L_1 is varied by rotating the shorted turn within it; L_2 is also fixed.

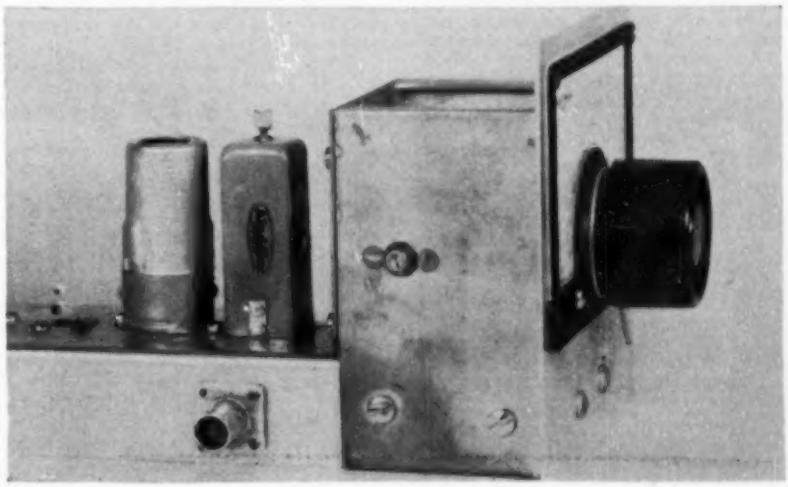


Fig. 4. The oscillator is in the shield box at right; the other components belong to the converter with which it is used. The oscillator is adaptable to any tunable converter. The chassis and shield are of heavy material for mechanical rigidity. Inside the shield, the 6AB4 is mounted upside down (Fig. 1) for short wiring leads.

TUNABLE HUM IN BROADCAST RECEIVERS

By **SIDNEY WALD**

Apply this method of tracing and eliminating an annoying hum in radio receivers to other types of interference.

SIXTY-CYCLE cross-modulation, popularly known as "tunable hum," has for a long time been a thorn in the side of the radio technician. Unlike the hum resulting from a defective or inadequately filtered a.c. power supply, this annoying form of interference may frequently frustrate the best efforts of well-trained service technicians to eliminate it.

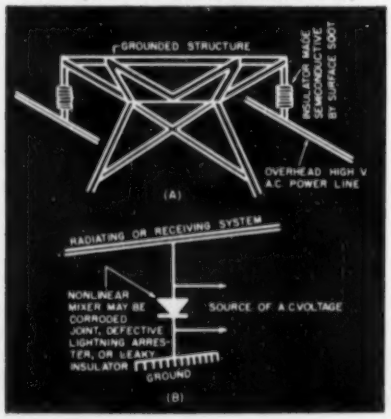
For the benefit of those few technicians who have never come up against this problem the following is a brief description of this malady.

"Tunable hum" is an affliction which may develop gradually or occur suddenly in an AM radio receiver. It is characterized by a strong distracting power line frequency hum which perversely enough appears only when the receiver is tuned to a broadcast station carrier. Between channels, the hum disappears completely, and, to complete the discouraging picture, the stronger the desired station's signal, the louder is the hum.

We may filter the power supply until we have piled up sufficient microfarads to buckle the legs on the service bench, but to no avail. As a matter of fact it is frequently possible to substitute a battery power supply without affecting the hum.

Of course, this last experiment, that of eliminating the a.c. power supply completely, furnishes us with a clue as to the origin of one of the most stubborn forms of tunable hum. Its cause must lie outside the receiver and the hum must, therefore, be a true modulation of the broadcast carrier frequency.

Fig. 2. Overhead a.c. power lines as shown in (A) pick up broadcast signals and re-radiate them with added 60 and 120 cps hum modulation. (B) is the equivalent circuit for the hum generator shown in (A) and in Fig. 1.


GROUNDED STRUCTURE
INSULATOR MADE SEMICONDUCTIVE BY SURFACE SOOT
OVERHEAD HIGH V A.C. POWER LINE
(A)
RADIATING OR RECEIVING SYSTEM
NONLINEAR MIXER MAY BE CORRODED JOINT, DEFECTIVE LIGHTNING ARRESTER, OR LEAKY INSULATOR
SOURCE OF A.C. VOLTAGE
GROUND
(B)

The writer's interest and curiosity in this subject was aroused a number of years ago, when, while visiting a friend, he was asked to apply some of his electrical engineering "know-how" to a troublesome line hum in the family radio receiver. It didn't take very long to discover that additional filtering of the power supply had absolutely no effect. Then, to further complicate the situation, it was observed over a period of several days that for hours at a time the receiver would be perfectly normal and free from interference and suddenly there would be a click and the same old hum would come on again, virtually ruining reception on all stations.

By this time rooting out this interference had assumed the nature of a technical challenge which the writer could not ignore.

During the ensuing investigation it was found that:

1. A second receiver, which was known to be in good condition, was subject to the same trouble when installed in the affected area.

2. This second receiver was battery-operated and immune to ordinary power line interference.

3. The interference was strongest when the outside antenna (located on the roof of the apartment house) was connected.

From here on, it was a matter of amateur detective work. A portable, battery-operated receiver, used to "sniff out" regions of highest hum intensity, pointed the way to the roof along the path of the antenna lead-in wire.

On the roof, the region of maximum intensity of tunable hum was found adjacent to a neighboring antenna, some 20 feet from the antenna belonging to the set with the initial complaint. The lead-in wire of the offending antenna was traced visually and the location of the apartment into which it entered was determined.

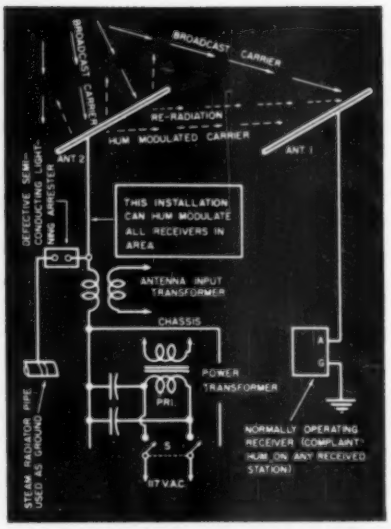


Fig. 1. 60-cycle hum originating in leaky lightning arrester at offending radio set is radiated by antenna to neighboring ones.

Gaining access to the receiver in this apartment with the co-operation of the occupant was not so simple but was finally accomplished. A glance at the broadcast receiver here disclosed nothing unusual until the set was turned on. A loud hum issued from the loudspeaker mingled with the broadcast signal; a turn of the tuning dial and it was gone. There was our old arch-enemy the tunable hum again. The writer asked the owner of the receiver, did she always have hum trouble? "Of course," came the answer, "we're used to it!" Immediately, the portable battery-operated receiver was turned on and from it, too, issued the annoying sound.

The next action proved to be the key to the whole problem. The receiver was turned off with the portable still operating. Amazingly enough, the hum disappeared leaving the broadcast signal clear and undistorted. There was no doubt about it, each time the receiver in question was switched on the hum would be present on the carrier received by the portable monitor. A quick check with the receiver owned by the writer's friend in the front apartment also showed his hum to come and go as the offending set was turned on and off in the second apartment.

An examination of the suspicious receiver installation disclosed nothing unusual except for a lightning arrester connected between the antenna post and a nearby steam radiator pipe. Disconnecting the lightning arrester proved to be the solution to the hum that had been plaguing the area. This defective unit was tested for leakage resistance and was found to have a resistance of about 50,000 ohms, whereas a good lightning arrester should be completely open between antenna and ground terminals.

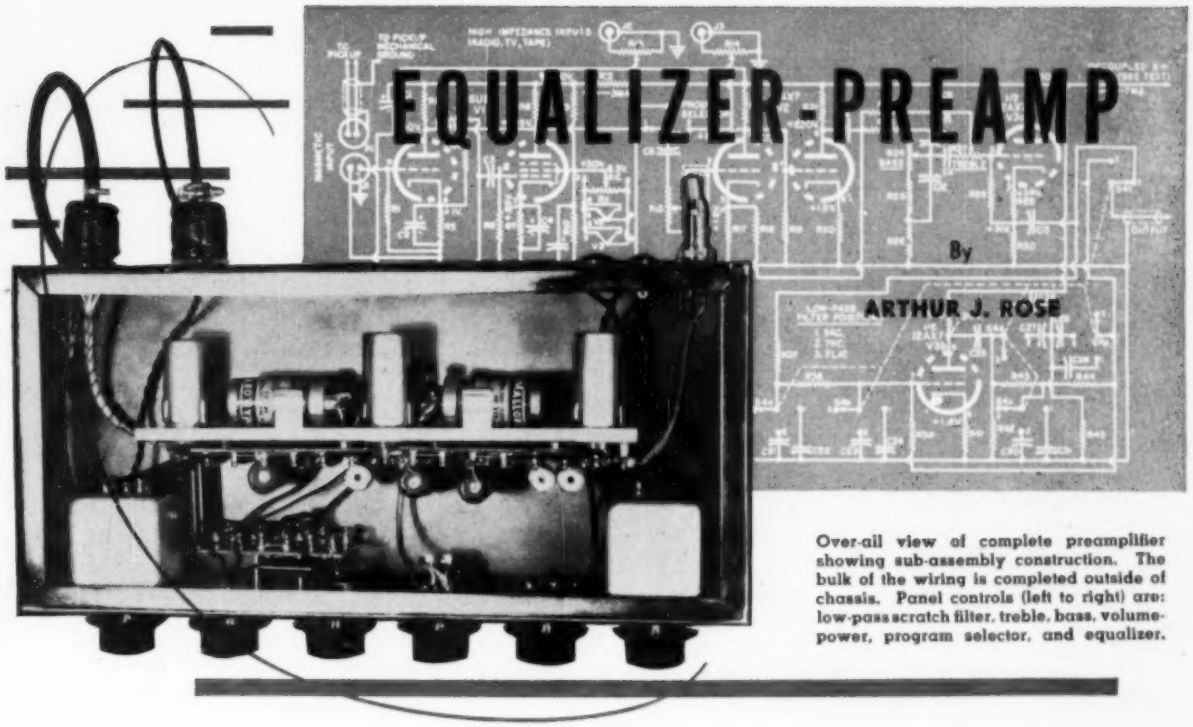
Apparently what happened was this: When the receiver was turned

(*Continued on page* 102)

EQUALIZER-PREAMP

By

ARTHUR J. ROSE



Over-all view of complete preamplifier showing sub-assembly construction. The bulk of the wiring is completed outside of chassis. Panel controls (left to right) are: low-pass scratch filter, treble, bass, volume-power, program selector, and equalizer.

Design details on a modern control unit engineered to provide flexibility and high quality performance.

MUCH of the information included in this article is presented in answer to the many inquiries submitted by those who read the author's earlier article[1] and towards fulfillment of a need for a universally applicable equalizer-preamplifier.

A summarization of the features deserving inclusion in the final design provides a basis for circuit development. Diversified opinions concerning certain auxiliary appliances are manifest among professionals and laymen alike. Therefore, it is not without some degree of subjectiveness that selections are given. However, it is felt that the majority of readers will regard them as the minimum necessary for consistency with the highest grade of equipment used to form the complete audio system. The design "check list" includes:

(*a*) Provision for incorporating and matching phono cartridge, radio, television, and tape inputs

(*b*) Control of over-all amplification

(*c*) Easily switched recording playback equalization

(*d*) Continuously variable bass compensation

(*e*) Continuously variable treble compensation

(*f*) Low-frequency rumble filter

(*g*) High-frequency noise filter

(*h*) Low impedance output

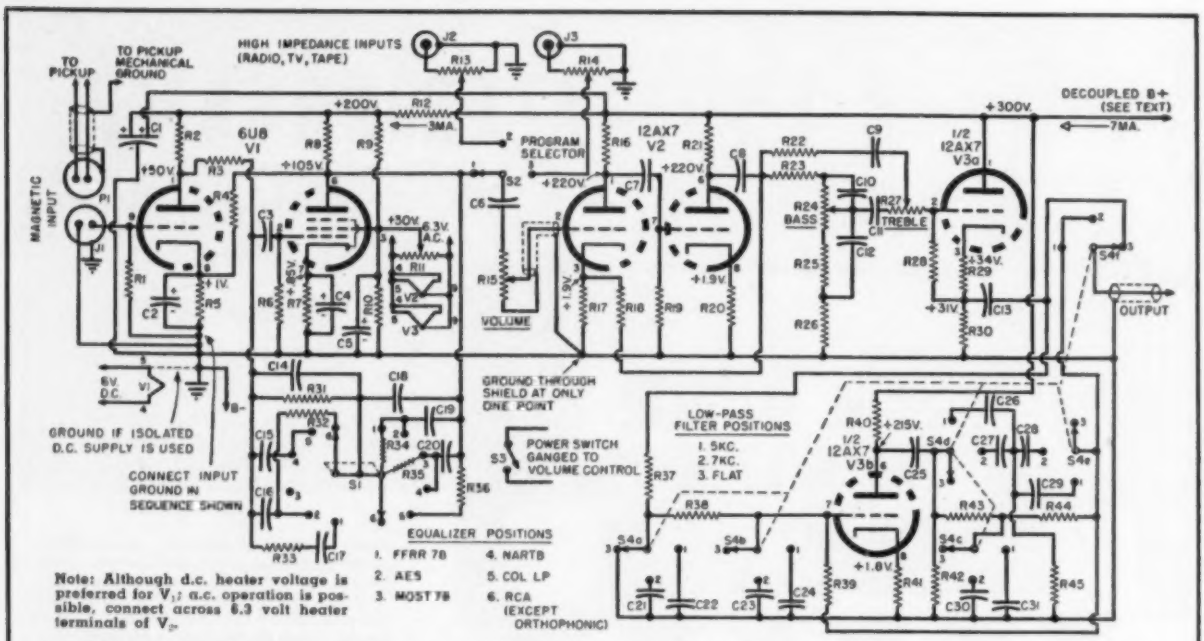
Along with desirable inclusions, other effects are subject to consideration. Instability, superfluous noises, and distortion are equally important as *un*desirables. Readers of the previous article will recall the blanket solution to the hum and noise problem. Wirewound resistors and a direct current heater supply are applicable in any design. If it were not for reasons to follow shortly, d.c. would be recommended for all applications. As will be appreciated by many, the final circuit permits a.c. operation in many cases. Distortion is maintained at a very low figure by proper tube operation and generous amounts of feedback. It should be noted that every stage, with the exception of the first, uses feedback.

Attention is directed to the schematic of Fig. 1. Preliminary inspection will reveal its sectionalization into a magnetic pickup preamplifier feeding a two-stage feedback amplifier. Tone controls follow this section into a cathode follower. In addition, there is the sharp cut-off low-pass filter that was described in the earlier article. More detailed study shows a six-position equalizer, rumble filter, and the method of using the cathode follower as a buffer between the low-pass filter and the balance of the circuit. When the filter is in the "flat" position, output is taken directly from the cathode follower. Otherwise, the output is taken from the filter where there is no need for a very low impedance output because of the deliberate attenuation of the higher frequencies. The low impedance source of the feedback amplifier and the high impedance loading of the cathode follower form an ideal condition for the tone controls. A direct approach to each section will greatly facilitate an understanding of the complete unit.

Playback Equalizer Section

There is no question in the writer's mind that feedback type equalizers are much to be preferred over "between the stages" types that offer no outstanding advantage such as reduction of distortion. As low as 20 cps, feedback types have distortion reduction factors great enough to be readily appreciated. Distortion at higher frequencies defies measurement; however, most feedback types are necessarily of the breed that introduces noise because of unbypassed cathodes. The equalizer stage to be presented does not have this difficulty nor does it have another drawback, to be mentioned shortly, that is common to the other types—even those with grounded cathodes. It is no more troublesome to construct although it requires more components.

It has come to be accepted that recordings need to be *exactly* equalized if the maximum of realistic reproduction is to be obtained. Because acoustic systems are subject to such wide variations, all equipment leading to the amplifier output terminals must be of unquestionable performance. This permits adjustment of the acoustic system. With properly equalized recordings, subsequent frequency-selective tone controls can be used effectively in co-ordinating differences in loudness levels and playback *vs* re-



Note: Although d.c. heater voltage is preferred for V_1; a.c. operation is possible, connect across 6.3 volt heater terminals of V_2.

R_1—47,000 ohms (G-E) or 27,000 ohms (Pickering)—recommended by the manufacturers
R_2, R_{11}, R_{16}, R_{23}—100,000 ohm, 1 w. wirewound res.
R_3—82,000 ohm, ½ w. carbon res. ± 10%
R_4, R_6—220,000 ohm, ½ w. carbon res. ± 10%
R_5—470 ohm, 1 w. wirewound res.
R_8, R_{10}—470,000 ohm, ½ w. carbon res. ± 10%
R_7—1000 ohm, ½ w. carbon res. ± 10%
R_{10}, R_{26}—47,000 ohm, ½ w. carbon res. ± 10%
R_{12}—100 ohm, 10 w. res. with adj. tap
R_{13}—33,000 ohm, ½ w. carbon res. ± 10%
R_{14}, R_{34}, R_{35}—1 megohm linear-taper pot
R_{17}—1800 ohm, 1 w. wirewound res.
R_{18}—120,000 ohm, ½ w. carbon res. ± 10%
R_{20}, R_{22}, R_{41}—1800 ohm, ½ w. carbon res. ± 10%
R_{21}, R_{26}—10,000 ohm, ½ w. carbon res. ± 10%
R_{22}, R_{23}—100,000 ohm, ½ w. carbon res. ± 10%
R_{24}—1 megohm audio-taper pot
R_{25}—10,000 ohm, ½ w. carbon res. ± 10%
R_{27}—100,000 ohm linear pot
R_{28}, R_{42}—1 megohm, ½ w. carbon res. ± 10%
R_{30}—33,000 ohm, 1 w. res.
R_{32}—62,000 ohm, ½ w. carbon res. ± 10%
R_{33}, R_{39}—3.3 megohm, ½ w. carbon res. ± 10%
R_{36}—820,000 ohm, ½ w. carbon res. ± 10%
R_{37}—100,000 ohm, ½ w. carbon res. ± 5%
R_{38}—470,000 ohm, ½ w. carbon res. ± 5%
R_{40}—560,000 ohm, ½ w. carbon. res. ± 10%
R_{43}—100,000 ohm, 1 w. res.
R_{44}, R_{45}—100,000 ohm, ½ w. carbon res. ± 1%
R_{45}—30,000 ohm, ½ w. carbon res. ± 1%
C_1—15/15 μfd., 330 v. elec. cond.
C_2, C_9—50 μfd., 25 v. elec. cond.
C_3, C_6, C_{11}, C_{12}—.02 μfd., 400 v. cond.
C_4—15 μfd., 350 v. elec. cond.
C_7—.01 μfd., 400 v. cond.
C_8, C_{29}—.05 μfd., 400 v. cond.
C_9—150 μμfd., 500 v. ceramic cond.
C_{10}, C_{14}, C_{15}—.002 μfd., 500 v. ceramic cond. ± 10%
C_{13}—.25 μfd., 400 v. cond.
C_{17}—50 μμfd., 500 v. ceramic cond.
C_{25}, C_{26}—.001 μfd., 500 v. ceramic cond. ± 10%
C_{16}—500 μμfd., 500 v. ceramic cond. ± 10%
C_{17}—200 μμfd., 500 v. ceramic cond. ±10%
C_{21}—200 μμfd., 500 v. ceramic cond. ± 5%
C_{22}—300 μμfd., 500 v. ceramic cond. ± 5%
C_{23}—30 μμfd., 300 v. ceramic cond. ± 5%
C_{24}—100 μμfd., 500 v. ceramic cond. ± 5%
C_{28}, C_{32}—150 μμfd., 500 v. ceramic cond. ± 1%
C_{27}, C_{28}—100 μμfd., 500 v. ceramic cond. ± 1%
C_{30}—200 μμfd., 500 v. ceramic cond. ± 1%
C_{31}—300 μμfd., 500 v. ceramic cond. ± 1%
P_1—2-prong shielded plug (Amphenol 80-MC2M)
J_1—2-prong shielded receptacle (Amphenol 80-PC2F)
J_2, J_3—RCA-type phono receptacle
S_1—D.p. 6-pos. rotary sw. (Mallory 3126J)
S_2—S.p. 3-pos. rotary sw. (Centralab 1461)
S_3—S.p.s.t. sw. (on R_{14})
S_4—6-pole, 3-pos. rotary sw. (Mallory 3163J)
All switches are shorting type (make before break)
V_1—6U8 tube
V_2, V_3—12AX7 tube

Fig. 1. Complete schematic diagram of equalizer-preamplifier. Precision parts are used throughout to insure quality performance.

cording acoustics. Lack of bass, especially at low levels, is sometimes the fault of the speaker or its acoustic environment. Often, however, it is due to insufficient bass equalization in the recording equalizer stage, in which circumstance even full use of the bass tone control will not prove to be enough.

Familiar twin-triode feedback equalizers are incapable of the 6 db-per-octave rate necessary in many playback requirements for proper bass equalization. This may come as a surprise to many because of the popularity of the various arrangements using triodes. The main reason for this is insufficient loop gain. Under ideal conditions, a gain of 2500 or so can be expected from cascaded 12AX7 sections and about 900 for a 12AY7. This in itself is poor. Aggravation of the situation appears with an unbypassed first cathode resistor that cuts these values by more than 50%. Since this situation has not been well publicized, it is desirable to present a brief supporting analysis.

An important factor in the maximum available rate of boost from *any* feedback equalizer is the ratio of midband loop gain (gain without feedback) to the over-all midband gain (gain with feedback). Examination of Fig. 2 will show the response that can be expected for different values of the ratio, A_o/G_o. These curves are based on stages with sufficient coupling and bypassing well below 10 cps. The 12AX7 example with the commonly used over-all midband gain of 50 can, at best, produce a curve somewhere between the ones shown for ratios of 20 and 40. In like fashion, the 12AY7 will produce the 20 curve. Because the feedback can be considered almost purely reactive (at lower frequencies) and therefore double in value every octave is no cause for a 6 db-per-octave rate here. In fact, for any circuit to produce this rate, an infinite ratio is required as the equation in Fig. 2 shows. At 50 cps, with a 500 cps turnover, 20 db boost ($C = 10$) corresponds to 6 db-per-octave from the turnover. Substitution of these values in the equation will cause the denominator to go to zero with a subsequent impossible gain requirement.

With this in mind, several alternatives are possible. Ratios in the neighborhood of 80:1 can be obtained by dropping the over-all gain with more feedback or by raising the loop gain by the use of pentodes. To drop the over-all gain with triodes would entail using feedback components that would load the stage to excess and would require condensers of physical proportions too staggering for space requirements. Chances are that the requisite G_o would be too small for application.

A compromise using a high gain pentode with a sufficient A_o/G_o ratio and an unfedback triode first stage

gives proper compensation and permits bypassing of the first cathode—a threefold advantage. Bypassing greatly lowers first stage noise, permits a.c. heater operation and gives higher gain. Attenuation due to the feedback isolation resistor requires that the triode precede the pentode for maximum signal-to-noise ratio.

"Natural" for this application is the 6U8 triode-pentode. Designed primarily for r.f. use, 6U8's are newcomers to audio. They have microphonic tendencies, but no more so than other types used often in similar circuits. Some selection at the parts dealer will help: hold the tube by the pins and tap it with a fingernail while listening for various *bings* and *bongs*. After about ten hours use, many of these tubes will become much quieter. Their thermal noise naturally varies from tube to tube, but has been found to be quite low especially with the circuit shown. 6AU6's with extremely low hum and noise levels can be substituted where one envelope is not deemed advantageous or where higher gain is desired. This will be further discussed with the next section.

An over-all midband gain of 25 to 30 can be expected from the first section. The pentode has a loop gain of 185 and is reduced by feedback to about 1.25. The triode stage has a gain of 20.

Equalization is provided for what the writer believes to be the majority of the recordings in use. Rather than use a separate network for each position, the switching uses a minimum of parts to achieve the correct values. For those with special requirements, a table is provided in Fig. 3 that will enable quick selection of components. These have been derived by network transformations of values generally given for "between the stages" equalizers.[2]

Wirewound resistors are specified in all places where their use contributes to lowered noise. Bypassing of R_5 is effective only above 20 cps, therefore this resistor must be wirewound to prevent low frequency noise. C_{14} has been added to prevent high frequency instability. It has no attenuating effect in the audible region.

A single resistor, R_4, does a lot of work in this circuit. The addition of this component completes the rumble-filter scheme. First, coupling constants throughout the unit were chosen to give roll-off below 20 cps. R_5 and C_2 are similarly chosen. Feedback from the pentode stage *via* R_4 is operative only when the impedance of the triode cathode rises—at very low frequencies. The combined effect is to give a fairly rapid attenuation below 20 cps without altering response above that frequency. Experiments with parallel-T networks have shown that while the attenuation rate is greater, the improvement does not justify the added complication.

Second Section

Input requirements of the various final amplifiers vary from 0.5 to 1.5 volts. The output of the preamplifier is largely determined by the second section.

Again feedback has been called upon to provide amplification that is distortionless and virtually independent of tube characteristic or supply voltage variations. To ensure this, the loop gain must be high enough to have A_o/G_o large compared to one. The feedback must not, however, be great enough to excite oscillation and some caution is advised. As shown, the gain is nearly 67 and is determined almost solely by R_{13}/R_{17}. For lower gain, R_{13} has to be lowered and a 12AU7 should be used. For higher gain, bypassing of R_{20} may be required in addition to increasing the value of R_{13}. If higher gain is contemplated, it should be borne in mind that tube noise from this section, as well from the first section, will increase proportionately. 6AU6's will have to be used in the first section with a d.c. heater supply. The d.c. is recommended there, as shown in Fig. 1, because the gain is high by usual preamplifier standards. Lower gains will suffice with cartridg-

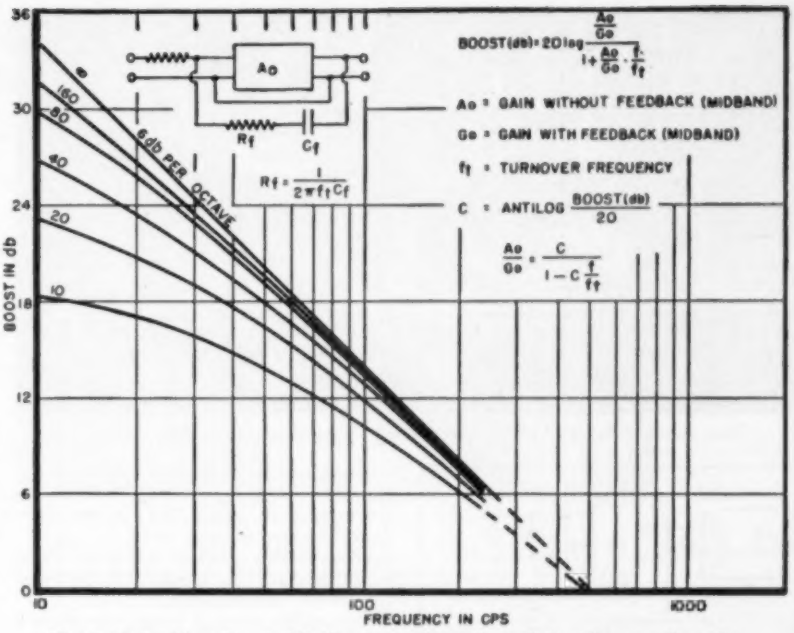
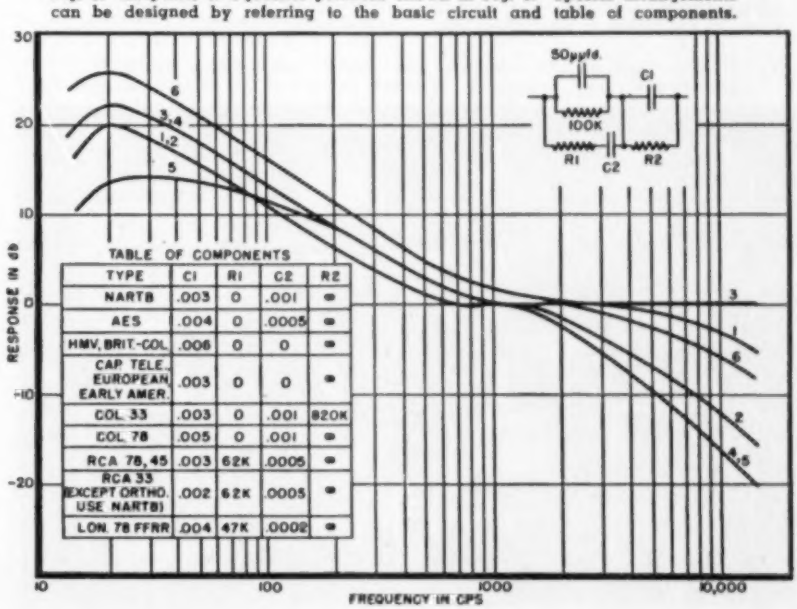
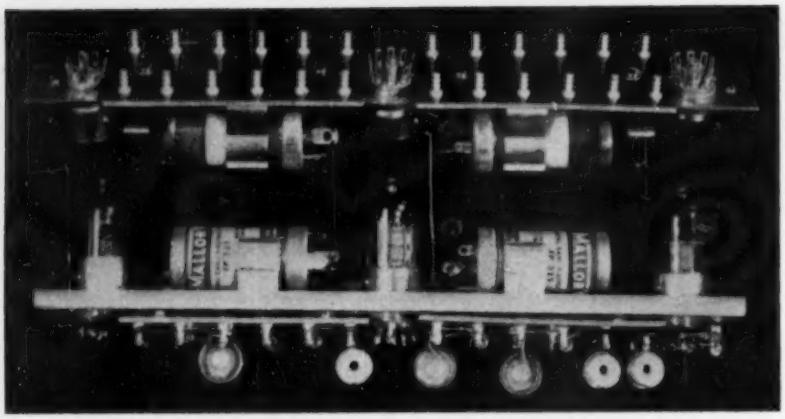


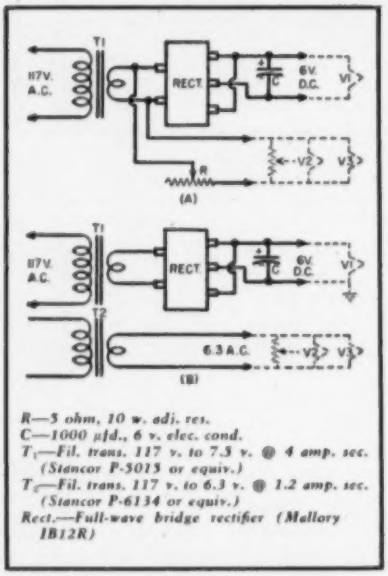
Fig. 2. Rate of bass boost of feedback equalizers depends largely upon the ratio of midband gain with and without feedback. Text points out shortcomings of many equalizers using degeneration and offers basis for development of unique circuit.

Fig. 3. Response of equalizer positions shown in Fig. 1. Special arrangements can be designed by referring to the basic circuit and table of components.





Two views of the sub-assembly at different stages of its construction. See text.



R—5 ohm, 10 w. adj. res.
C—1000 μfd., 6 v. elec. cond.
T_1—Fil. trans. 117 v. to 7.3 v. @ 4 amp. sec. (Stancor P-5015 or equiv.)
T_2—Fil. trans. 117 v. to 6.3 v. @ 1.2 amp. sec. (Stancor P-6134 or equiv.)
Rect.—Full-wave bridge rectifier (Mallory IB12R)

Fig. 4. Two easily-built d.c. heater supplies designed to be used with the first stages of the high-gain preamplifier unit.

es such as the *Pickering* which has an output of over 50 millivolts. With the lower output types, such as the *General Electric*, a gain of 50 or more is needed in this section unless the final amplifier is more sensitive than those ordinarily encountered.

Maximum output from the second section is slightly more than 40 volts. After subsequent attenuation by the tone controls and cathode follower, the available preamplifier output is over 3.5 volts.

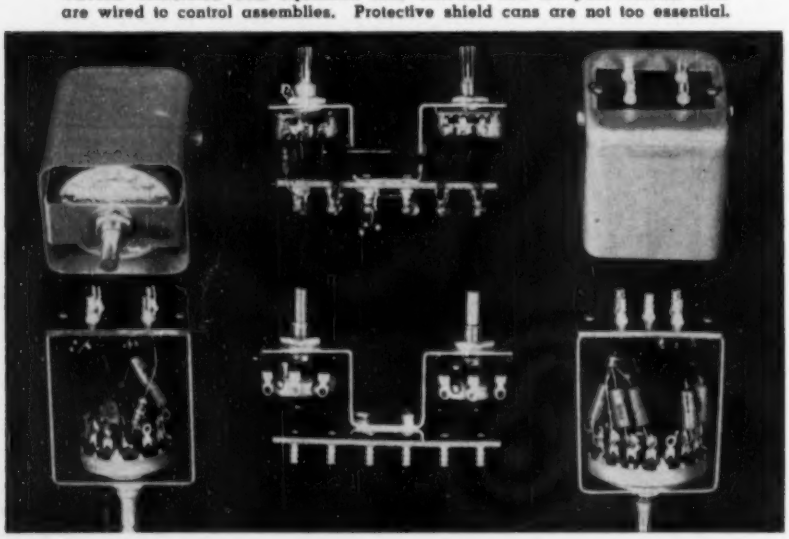
High impedance inputs should be preset to permit full use of the volume control without overloading the feedback amplifier. Maximum input to the volume control is approximately $60{,}000/R_{15}$ volts.

Tone Controls

An unusual combination of bass and treble controls was chosen because of its smooth action. The treble circuit gives only boost and is entirely satisfactory when de-emphasis is correctly applied in the equalizer stage and when the low-pass filter is available. Experience has shown that this is true with input material other than phono provided the source is properly balanced. Usually it is the predominance of a maladjusted tweeter that is to blame when highs cannot be brought under control with a treble control of this type. Known as variable "degree" as opposed to variable "slope," its effect is to lift the middle as well as the top highs, thereby giving a more balanced action. Boost and droop are more applicable to the bass end with a variable slope control. This is to be preferred in that region.

Output from the cathode follower is about 0.85 times its input. The output impedance is nearly 500 ohms. Because of the elevated cathode, heater returns should be made to a similar potential. The pentode screen grid is an ideal place.

Circuits associated with equalizer, tone controls, and low-pass scratch filter are wired to control assemblies. Protective shield cans are not too essential.



Low-Pass Filter

Comment about this stage is limited to information not mentioned in the earlier article. R_{29} and R_{30} have been chosen to bring the gain to unity so there will be no change in level when the filter is switched from flat to cut-off.

Bypassing R_{31} is not recommended as it produces a peak in the response. The loop gain has been increased by the use of a 12AX7 section instead of a 12AU7 and produces an optimum cut-off characteristic for the given component tolerances with a gain of about 25.

Experimenters who wish to investigate the possibilities of a variable slope filter can try variations of the loop gain by placing a potentiometer in the loop or by bridging the T-network with a variable resistor, etc. A wide variation of slope is possible, but full variation from flat to extreme cut-off would seem difficult to obtain. At present, sufficient data is not available to quote definite capabilities.

Power Supply

Duplication of the voltages shown on the schematic is probable within 10% with a supply of 300 volts. Voltages as low as 250 volts can be successfully used. In any event, the supply must be isolated by a resistance greater than 10,000 ohms if the main amplifier is to furnish the plate power. Ideally, a well decoupled point should be chosen in the final amplifier that will supply at least 370 volts with the additional 7 ma. loading of the preamplifier.

A separate power supply need only furnish 250 to 300 volts and in the interest of flexibility and sure-fire simplicity this is to be recommended. Self-powered preamplifiers are coming more into their own because of the desire of most experimenters to try their units with many different final amplifiers.

Heaters must be supplied with a separate winding and preferably a separate transformer. Conditions for a.c. or d.c. operation of the playback-equalizer (first) section heaters have been stated. Since the 6U8 draws 450

(*Continued on page* 112)

A $5 LOW-PASS FILTER

By J. G. ROUNTREE
W5CLF

A good low-pass filter for medium-power rigs can be had at reasonable cost.

The internal view of the low-pass filter shows its simplicity. The 2" brass-pipe case gives perfect shielding. Note the ceramic condensers.

IN SPITE of anyone's wishful thinking to the contrary, television is here to stay. As a result, greater demands than ever are now put on the amateur to achieve purity of signal, so that any interference will not be the result of harmonic or spurious emissions from the amateur transmitter. We are all painfully aware of the shortcomings in the design and fabrication of some television receivers and we should give due credit and strong support to those few courageous amateurs who have outspokenly challenged the shoddy practices of many TV receiver manufacturers. We must also give credit and support to those manufacturers who have installed high-pass filters in receivers already sold and have improved their designs to correct deficiencies.

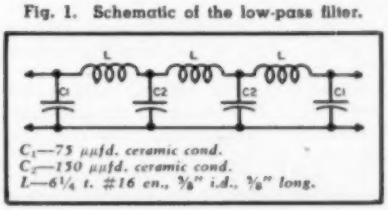
The position of each of us and of amateur radio as a whole can be strengthened through our being certain that our own equipment is designed and working properly. It was with this in mind that the writer recently purchased a new TVI-proofed transmitter. It was decided that, as a further safeguard against harmonic radiation, some sort of filter should be placed between the transmitter and the antenna to attenuate any possible harmonics. Having already invested a goodly sum in the transmitter, it was with some dismay that we examined the prices of suitable low-pass filters for transmitters. There seemed to be no reason why a satisfactory home-grown filter could not be built at relatively low cost.

Reference to a radio engineering handbook showed that a three-section pi network should be relatively effective and quite simple to build. The question arose as to whether close tolerances would need to be observed in the component parts, but a little pencil work with the handbook formulas showed that a reasonable degree of tolerance could be allowed. Since the lowest-frequency television allocation in the Dallas-Fort Worth area is Channel 4, it was considered that the simple low-pass pi network would achieve a suitably high attenuation at this channel. This proved to be the case. Where the lowest-frequency allocation is Channel 2, an M-derived filter would provide higher attenuation at Channel 2.

As a starting point the frequency 40 mc., approximately midway between the upper end of the 10-meter band and the lower end of Channel 2, was chosen as the cut-off frequency. The network was designed to work in a 52-ohm line, such as type RG/8-U. Design values for the shunt condensers were worked out from handbook formulas; and commercially-available disc ceramics, nominally rated very close to the design values, were purchased. These condensers are rated at 500 volts and should stand up very well in service for transmitter powers of up to 200 watts or so, provided that the standing-wave ratio of the transmission line is kept within reason. Design values for the coils were likewise worked out, and parameters of the coils were determined by use of a "Lightning Calculator." See Fig. 1 for the circuit diagram of the filter.

The pi network was built in a three-section chassis made of four circular brass shields spaced on four ⅛-inch brass rods, each seven inches long. The rods were threaded with 9/32 threads for their entire length. The shields were cut from 20-gauge brass, carefully trimmed to fit smoothly inside a two-inch brass tube, and were spaced at equal distances along the brass rods. The two end shields contain coaxial fittings, while the two intermediate shields contain *National* TPB feedthrough bushings. The end coils of the network were soldered between the coaxial fittings and the adjacent bushings, while the center coil was soldered in place between the feedthrough bushings. The shunt condensers were soldered in place between the coils and the shields by as short a path as possible.

Fig. 1. Schematic of the low-pass filter.



C_1—75 μμfd. ceramic cond.
C_2—150 μμfd. ceramic cond.
L—6¼ t. #16 en., ⅜" i.d., ⅛" long.

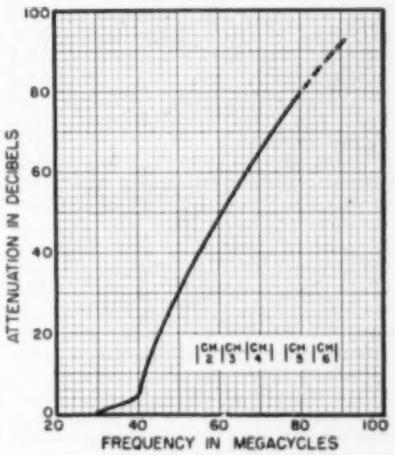


Fig. 2. Attenuation curve of the $5 filter.

The entire assembly was slipped into a seven-inch length of two-inch brass pipe. Before the end shields were soldered in place, the assembled unit was baked at a moderate temperature for about fifteen minutes to drive out any moisture remaining in the unit. While the filter could be mounted in several ways, it has been found that two U-bolts, made of ⅛-inch brass rods, provide a simple way of bolting the filter to the back of the transmitter cabinet.

After completion of the unit, a test was made to determine the effectiveness of the filter. Fig. 2 is a graph showing the results of this test. It will be noted that the attenuation is negligible below 30 mc., and that it increases to more than 40 db for Channel 2, 50 db for Channel 3, and 59 db

(*Continued on page 102*)

D.C. DISTRIBUTION IN TV RECEIVERS

By
WALTER H. BUCHSBAUM
Television Consultant
RADIO & TELEVISION NEWS

You can use an ordinary v.o.m. for rapid TV servicing when you know the theory and operation of the d.c. receiver circuits and their normal measurements.

HIT or miss troubleshooting procedures can never make TV servicing a profitable business. A definite method is needed in all service work. This is especially true of locating defects and giving estimates right in the home, where a rapid, simple procedure is essential. Furthermore, this procedure must use only a few compact test instruments. All this suggests the most basic approach—d.c. measurements.

Every service technician knows how to measure "B+" voltages, but in today's complicated TV models a single voltage reading is often not sufficient to locate the defective part. Different models use greatly different circuits, exact diagrams with voltage figures are usually not available in the home, and the variation in tubes and line voltage further complicates d.c. troubleshooting. Yet the d.c. operation of most stages in a TV set is a direct indication of its over-all performance and can be used to spot a large number of common defects. This article will show the service technician how he can troubleshoot any TV set in the customer's home with only a simple v.o.m. and a good understanding of the d.c. paths in the set.

D.C. per Stage

Any TV receiver can be broken up into a series of circuits each of which has a tube as its center. A signal is applied at the grid or cathode and is taken off at either the plate or cathode. What happens to the amplitude and waveshape of this signal depends on such fixed components as coils, condensers, and resistors and on the d.c. voltages and currents applied to the tube. Assuming that the filaments light up and the coils are not shorted, the entire tube circuit can be examined on a d.c. basis only.

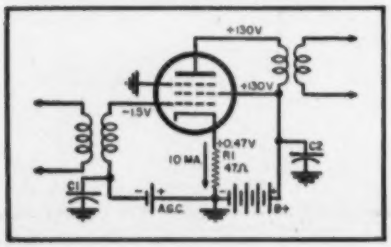
OHM'S LAW	EXAMPLE
VOLTAGE = CURRENT × RESISTANCE	1V = 1MA × 1K = 10MA × 100Ω 10V = 10MA × 1K = 100MA × 100Ω 100V = 10MA × 10K = 100MA × 1K
CURRENT = $\frac{\text{VOLTAGE}}{\text{RESISTANCE}}$	1MA = $\frac{10V}{10K}$ = $\frac{100V}{100K}$ 10MA = $\frac{1V}{100\Omega}$ = $\frac{10V}{1K}$ 100MA = $\frac{10V}{100\Omega}$ = $\frac{100V}{1K}$
RESISTANCE = $\frac{\text{VOLTAGE}}{\text{CURRENT}}$	10Ω = $\frac{1V}{100MA}$ = $\frac{10V}{1AMP}$ 100Ω = $\frac{1V}{10MA}$ = $\frac{10V}{100MA}$ 1K = $\frac{10V}{10MA}$ = $\frac{100V}{100MA}$

Table 1. Various forms of Ohm's law with examples, for use in d.c. measurements.

Fig. 1 illustrates a typical i.f. stage. The current through the tube results in a 0.47-volt drop across R_1, the cathode resistor. If the —1.5-volt bias was absent the tube current would rise, possibly up to 20 ma., and the voltage across R_1 would be close to 1 volt. A single voltage measurement can, therefore, tell us all pertinent facts about this stage. If we measure about 0.5 volt across the 47-ohm cathode resistor we know that the grid bias is correct which means the grid coil is not open and C_1 is not shorted. We also know that the screen and plate are receiving approximately the right voltage and that C_2 is not shorted and the plate coil is not open. The remaining possible defects narrow down to misalignment, shorted turns in either coil, or possibly a bad tube. The last is unlikely since tube emission must be good to give proper voltages. Thus the operation of an entire stage can be checked with a single d.c. voltage measurement.

Most forms of service data show the correct d.c. voltages for all tube elements. To interpret correctly the meaning of an incorrect voltage at any point, the service technician should understand the d.c. operation of the entire set. Basically all one needs to know is Ohm's law in its different forms. Some helpful data on this is given in Table 1.

Fig. 1. TV receiver i.f. stage showing normal d.c. readings for the circuit.



To check the d.c. operation of any amplifier tube, simply check the tube current. This is easiest where a cathode resistor is used. If the cathode is grounded, measure the plate current by reading the voltage across either the plate load resistor or a series decoupling resistor. In most cases where correct plate current and voltage are found, the control and screen grids will also be operating correctly.

Oscillators which are operating properly have grid-leak bias, and therefore draw less current than when some defect prevents proper oscillation. During improper operation the tube current often rises beyond the tube operating limits.

Three different oscillators are found in TV sets: the local oscillator in the tuner, the vertical, and the horizontal saw-tooth generators. Local oscillators, either v.h.f or u.h.f, usually require about 120 to 150 volts with 10 to 25 ma. of current. To check these do not measure grid bias, but connect the d.c. voltmeter across the plate decoupling resistor, usually 150 ohms. If the tube is oscillating the meter reading will increase when a screwdriver tip is brought near the tank circuit. This check does not determine the oscillator frequency, but in the absence of either sound or picture it indicates whether or not the oscillator is working.

The vertical and horizontal oscillators can be checked by measuring the grid bias. Touching the grid with the meter probe will shift the frequency somewhat, but here again only the operation of the stage is checked. Actual bias voltages vary from —10 volts for some horizontal circuits to —25 volts for vertical blocking oscillators. Remember that bias should be measured between the grid and cathode pins of the tube. In addition to bias, the voltage drop read across the plate load resistor will show the current and thereby completely cover the tube operation.

Clipper and limiter circuits invariably draw very little d.c. power since they operate at cut-off most of the time.

D.C. Distribution in Over-all Receiver

In addition to being able to perform d.c. tests on individual stages the technician must also know how the over-all d.c. network in a TV set works and what voltages and currents can be expected in each section.

The basic d.c. system for any TV set is equivalent to that of a power supply and a load. The power supply converts the a.c. power into a d.c. voltage, usually much higher than the 117-volt a.c. line, and a certain amount of current which then operates the various tubes in the receiver. Fig. 2 shows the schematic diagram of a typical power supply and its equivalent circuit. The equivalent circuit of the transformer full-wave rectifier and pi-type filter is a simple battery with the voltage V, supplying a current I. In this example we assume that the entire TV receiver is supplied by this same voltage and the total of the currents drawn by each tube is equal to I. Some TV receivers have a d.c. system where only a single "B+" voltage is used for all stages, but the majority of sets employ more complicated schemes.

The i.f. amplifier tubes are rated at about 150 volt plate and screen voltage, while some of the sweep oscillators and video and sweep amplifiers require between 250 and 400 volts plate supply. One simple solution to the problem of supplying two widely different plate voltages is the scheme used in the original 630 type receivers. This is shown in Fig. 3, and consists mainly of a resistive voltage divider which supplies the various correct voltages and currents to each section. The excess power is dissipated in the bleeder resistors which are usually of the wirewound type. While this circuit results in fairly good regulation and certainly is convenient and simple to understand, it is not very economical. Because of the power dissipated in the bleeder resistors, more d.c. power must be supplied than the tubes actually use. This requires an expensive power transformer, two 5U4 rectifiers, extra components and results in extra heat in the chassis.

To utilize the "B+" power more fully, modern TV receivers use a number of schemes for eliminating dropping resistors whenever possible. One very widely used economy circuit is shown in Fig. 4A. As mentioned before, the i.f. stages require between 120 and 150 volts for the plate and screen supply. Similarly, the audio output amplifier can be designed to use approximately the same voltage. If the main "B+" voltage was 270 volts the simplest arrangement would be the one in Fig. 4C, where resistors R_1 and R_2 drop the voltage down to the level required and dissipate the excess power. In Fig. 4C, the power delivered by the power supply is 270 volts at 70 ma. or about 19 watts. Almost half of this power is dissipated in the bleeder resistors.

Now look at the circuit in Fig. 4A. Here the audio amplifier is in series with the three i.f. stages as far as d.c. is concerned. The 6V6 output tube serves as a dropping resistor to lower the voltage for the three i.f. stages. Both of these loads use the same current and, in effect, the 6V6 output tube serves to regulate the i.f. plate voltages.

Assume that the "B+" voltage drops slightly due to line voltage variations. This means that the cathode bias of the 6V6 is reduced, allowing this tube to pass more current and therefore maintain the voltage on the three i.f. tubes. Similarly, an increase in "B+" voltage means an increase in 6V6 bias which again keeps the "B+" voltage for the i.f. section relatively constant. Because the total gain in the i.f. section is large, variations in plate supply voltage of the i.f. tubes have much more effect than "B+" variations in the 6V6 audio amplifier.

A very important feature of the circuit in Fig. 4A, is the two condensers C_1 and C_2. These condensers provide low a.c. impedance paths for the audio signal and for the i.f. signal, keeping the "B+" for both series loads a true d.c. voltage. If either was open, motorboating in the audio, and audio variations in the i.f. signal would result. If C_2 was leaky or even shorted, the entire 270 volts would be applied to the 6V6 tube. Because the tube has a self-bias arrangement and is capable of handling such a high plate voltage, the 6V6 would not burn out. However, there would be very little or no plate and screen voltage for the i.f. stages, cutting off the picture signal and, in an intercarrier set, the sound signal as well. If condenser C_1 is shorted, the excessive plate voltage on the i.f. tubes could cause oscillation, overloading of the last stage due to excessive gain in the first two and, eventually, the i.f. tubes would burn out, one by one.

The third electrolytic condenser failure which can cause trouble involves C_3, the 6V6 cathode bypass condenser. If this condenser opens, the sound output will be greatly reduced and some audio may appear in the picture, but otherwise nothing will burn out or be damaged. If C_3 shorts, however, considerable damage can result. Such a short would result in the 6V6 being operated with almost zero bias. This will increase the current through the 6V6 considerably and will raise the "B+" voltage available to the i.f. stages. While the sound will be quite distorted, the excessive "B+" may cause the i.f. stages to become regenerative. The a.g.c. system may be unable to control the gain of the i.f. stages with such high plate voltages and cause overloading, i.f. oscillation, or picture distortion in the video amplifiers.

The circuit shown in Fig. 4A repre-

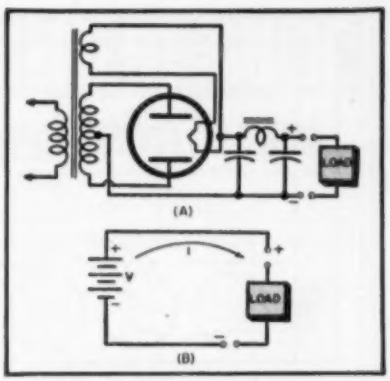


Fig. 2. (A) Typical low-voltage power supply with its equivalent circuit (B).

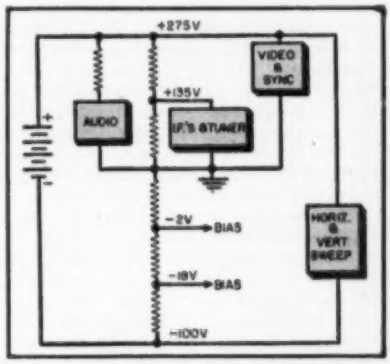


Fig. 3. Simplified 630-type d.c. circuit.

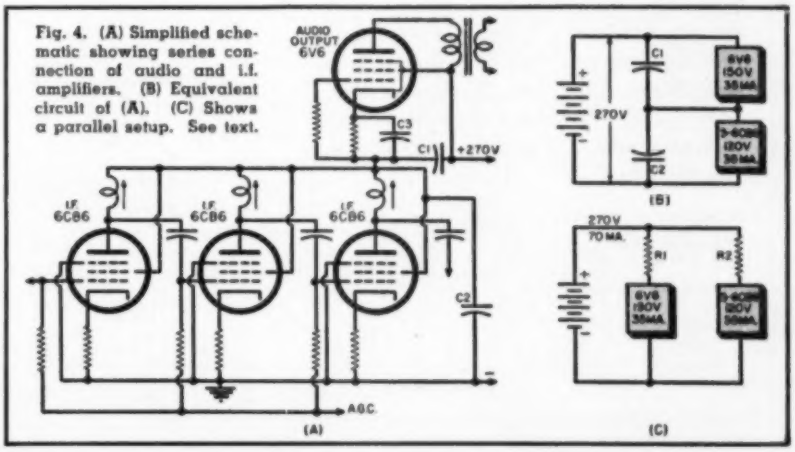


Fig. 4. (A) Simplified schematic showing series connection of audio and i.f. amplifiers. (B) Equivalent circuit of (A). (C) Shows a parallel setup. See text.

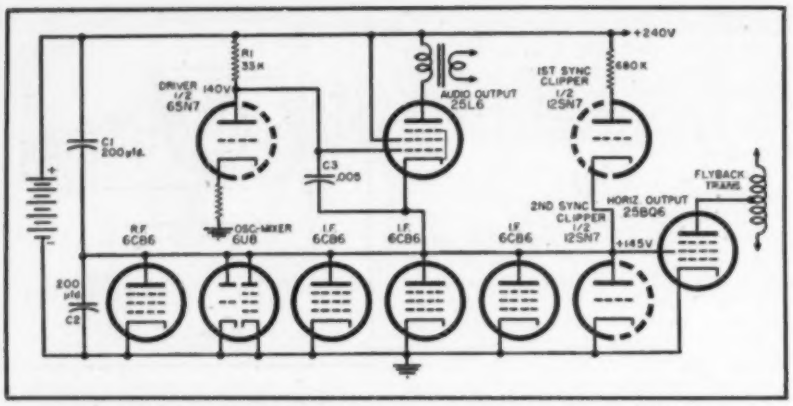


Fig. 5. Series-type d.c. distribution circuit as used in the Motorola 17F12.

sents only the important d.c. elements and omits such details as decoupling resistors, i.f. bypass condensers, heater circuit, etc. It should be understood, however, that failure in any one of these omitted parts can affect the d.c. distribution and cause trouble both in the i.f. and audio sections as a result of their series connection.

It becomes evident that a large number of defects occurring in the i.f. and audio sections can be located directly by checking the d.c. operation of these circuits. If the technician does not know of this series d.c. distribution it will be hard to associate the defect in the audio output stage with the symptoms found in the i.f. section. Whenever a series circuit is used, be sure to check both the total voltage and the lowered "B+" portion. For example, the voltage across the i.f. tubes in Fig. 4A should not exceed about 150 volts, but the voltage across the audio output tube must be the difference between the "B+" voltage and the i.f. plate voltage.

Another typical application of the series d.c. distribution method is shown in Fig. 5. This is a simplified presentation of the d.c. path of the *Motorola* models 17F12, 17K12, and 17T7, among others. Here a total of five stages, the tuner and i.f. amplifiers, are supplied with 145-volt "B+". In addition, the screen of the 25BQ6 horizontal output amplifier and the plate of the second sync clipper also go to the 145-volt point. The total current taken by the 145-volt source is approximately 60 ma., drawn through the 25L6 audio output tube and the first sync clipper. These two tubes are connected in parallel, but since the sync clipper has a high plate load resistor and generally uses much less current than the 25L6, the latter passes most of the current for the 145-volt line.

In analyzing this scheme we find it is somewhat more complicated than the circuit shown in Fig. 4A, and certainly a much greater number of defects can occur here. Assume, for example, that the 200 μfd. condenser, C_2, shorts out. This not only cuts the i.f. and tuner sections off, but will also kill the horizontal sweep and high voltage to the CRT since it grounds the screen of the 25BQ6. Furthermore, the audio output tube will tend to draw excessive current and burn out shortly.

The circuit used here for providing bias for the 25L6 is somewhat unusual. It uses the plate load resistor for the audio driver stage, R_1, to drop the 240-volt "B+" down to 140 volts. Since the cathode of the 25L6 is at 145 volts, the grid is 5 volts negative with respect to the cathode. If the driver tube goes bad and does not draw sufficient current, the voltage at the plate of the driver and the grid of the 25L6 may go higher than 140 volts. This can mean zero or even positive bias on the 25L6 with a resultant increase in current through the tube and an increase in the 145-volt line. When the 145-volt line is raised considerably, say to 200 volts, the tuner and i.f. sections can overload, oscillate, or become regenerative. The change in plate voltage will cause the local oscillator to shift its frequency so that it will appear misaligned. High plate voltage will also affect the operation of the second sync clipper, possibly wrecking horizontal or vertical sync or even upsetting both circuits. For the horizontal output tube the increase in screen voltage will mean more deflection and more high voltage.

There are many other possible defects which can have quite unexpected symptoms and present a problem in troubleshooting due to the complexity of the d.c. distribution in this set. By measuring the d.c. voltages, however, the source of the trouble can be found quickly. For this particular receiver it is only necessary to measure the 240-volt line, the 145-volt line and, if they are not quite correct, check the bias on the 25L6 and finally the bias on the i.f. tubes. All these measurements require only a simple d.c. meter.

We have taken the *Motorola* circuit of Fig. 5 as an example of the series connection scheme. There are many variations of this d.c. distribution system and almost all of them use the audio output tube as the major current path for getting a lower "B+" voltage for the i.f. section. In some instances the audio tube is shunted by a fixed, wirewound power resistor which supplies additional current. The principle and the method of troubleshooting remain the same. Always

Table 2. The voltage and current requirements for typical TV receiver stages.

STAGE	BIAS	PLATE	SCREEN	NOTES
TUNER				
6BK7, 6BQ7, 6BZ7	0.5-5 v.	150-250 v., 20 ma.		cascode circuit
6AK5, 6AG5, 6BC5, 6CB6	0.5-3 v.	150 v., 8 ma.	150 v., 2 ma.	
6J6, 12AT7		150 v., 15 ma.		oscillator
I.F.				
6AG5, 6CB6, 6BC5, 6AU6	0.5-5 v.	150 v., 8 ma.	150 v., 2 ma.	
VIDEO				
6AU6, 6CB6	1-5 v.	200 v., 8 ma.	150 v., 2 ma.	
6AC7, 6AH6	1-4 v.	300 v., 10 ma.	150 v., 2 ma.	
6AG7, 6CL6, 6K6, 6V6	1-4 v.	300 v., 35 ma.	150 v., 8 ma.	
6SN7, 12AU7	1-10 v.	300 v., 12 ma.		
12AT7	1-4 v.	200 v., 10 ma.		
SYNC				
6SN7, 12AU7, 12AT7		50-200 v., 3-10 ma.		great variation in different circuits
VERTICAL				
6SN7, 12AU7, 12AX7, 6C4	3-10 v.	200-400 v., 12 ma.		
12BH7, 6BL7, 6S4	3-12 v.	200-800 v., 20 ma.		
6K6, 6V6, 6AQ5, 25L6	2-15 v.	150-250 v., 35 ma.		triode connection
HORIZONTAL				
6SN7, 12AU7, 12AX7	5-15 v.	250-400 v., 10 ma.		osc. & a.f.c. tube voltage differ
6BG6, 19BG6	18-24 v.	400-500 v., 70-90 ma.	300 v., 15 ma.	
6CD6	16-20 v.	400-600 v., 80-110 ma.	350 v., 18 ma.	
6BQ6, 6AU5, 6AV5	20-25 v.	400-600 v., 50-70 ma.	150 v., 12 ma.	
6W4, 5V4, 35W4				measure only at boost point, 400-600 v.
AUDIO				
6AU6, 6CB6, 6BA6	1-6 v.	150 v., 8 ma.	150 v., 2 ma.	
6T8, 6AT6, 6AV6	1-3 v.	150 v., 1 ma.		
6K6, 6V6, 25L6, 6AQ5	6-15 v.	150-250 v., 25-40 ma.	200 v., 8 ma.	
POWER SUPPLY				
5U4				output up to 450 v., 225 ma.
5V4				output up to 400 v., 175 ma.
5Y3				output up to 450 v., 150 ma.
6X4				output up to 380 v., 70 ma.

The above are average values only and may vary in different receiver models.

check first if the cathode of the audio amplifier is returned to ground. Measure the voltage between the cathode and ground, then measure the voltage between the cathode and the i.f. "B+". If the latter measurement turns out to be only a few volts, a series circuit is employed and can be checked as described here.

One other section in most TV receivers is particularly prone to d.c. troubles and lends itself well to the d.c. troubleshooting procedure. That is the voltage boost portion of the horizontal flyback supply.

Boost Voltage

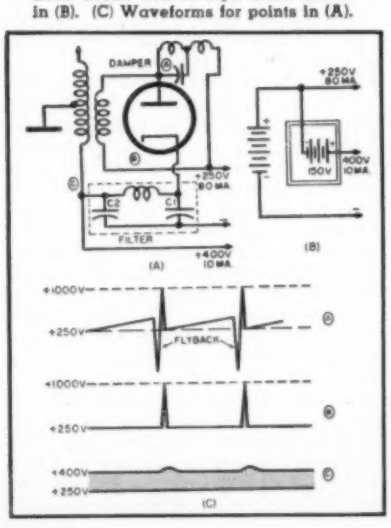
The operation of flyback circuits is quite complex since it involves impedance transformation from the horizontal output amplifier to the deflection yoke, HV step-up and rectification, and voltage boosting due to the damper tube action. For this discussion attention is focused only on the boost voltage portion of the circuit. However, it must be understood that the boost voltage is directly affected by and, in turn, has a different effect on the other two portions. A simple explanation of the boost supply is provided by Fig. 6A.

The flyback circuit shown here is typical of a majority of sets now in use. Many later models use an autotransformer, requiring that the damper tube connections be reversed, with the plate providing the boost voltage instead of the cathode. This does not change the operation or the results at all.

At point *A*, the damper plate, the large positive pulses due to the flywheel effect of the transformer and yoke cause the damper tube to conduct, passing the pulses to the cathode. These pulses are superimposed on the 250-volt "B+". Actually, these pulses will be filtered out somewhat at the cathode due to the action of the first filter condenser C_1, but for bet-

(*Continued on page* 116)

Fig. 6. (A) Typical damper and voltage boost circuit with its equivalent shown in (B). (C) Waveforms for points in (A).



TV PARTS REPLACEMENT GUIDE

TV POWER TRANSFORMERS

Continuation of list of power transformers used in TV sets and their replacements; to be concluded next month.

All data was furnished by the parts manufacturers listed.

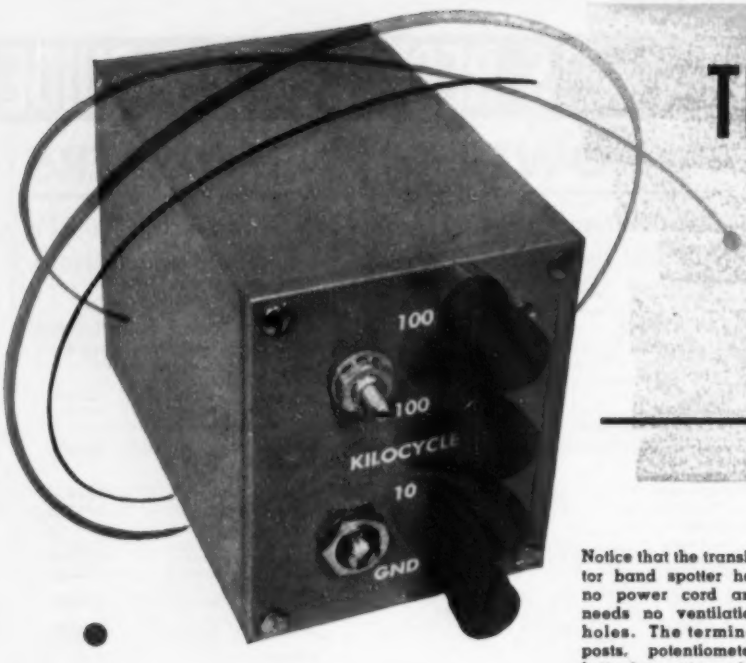
RECEIVER MFR. Part No.	CHICAGO Part No.	HALLDORSON Part No.	MERIT Part No.	TRIAD Part No.	THORDARSON Part No.
CAPEHART					
94231	PH-90	P9307	P-3066	R-11B	TS-24R04
94264		F5516		F-21A	T-21F12
94269		P9727	P-3066		
650243A-1		F5530	P-3097	F-50X	
750019B-1				R-37BC	T-26R00
750019C-1		P9727	P-3067		
750121A-1		P9711	P-3059		
750144A-1	TP-409	P9719	P-3067	R-37BC	T-26R00
750144B-3	TP-409		P-3067*	R-33BC	T-26R19
CROSLEY					
B-144460	TP-355	P9713	P-3059	R-35BC	T-26R19
C-146683	TP-392†	P9711	P-3078	R-38BC	T-26R00
C-147304		P9723	P-3078	R-42B & F-52X	T-26R00
C-147682	PH-145 & FO-63	P9731	P-3066	R-38BC	T-26R00
C-148282	PH-200 & FO-63	P-9711	P-3059	R-20B & F-16X	T-26R23
C-148562			P-3067, 3074		
C-148950				R-39BC	T-26R21
C-148975		P9713	P-3078	R-42BC	T-26R25U
C-149559		P9711	P-3063		
C-151612	TP-356†	P9713	P-3059		
C-152433	TP-370†		P-3063		
D-145609				R-30A	
D-160011		P9721		R-31A	T-26R00
D-160318	PH-70	P9311	P-2952	R-11B	TS-24R04
D-160490				R-40A	
DEWALD					
1050	TP-365	P9721	P-3061	R-31BC	T-26R00
1130A	TP-370†	P9705	P-3070	R-38BC	T-26R21
DU MONT					
20D-12404, 20D-12926	PH-70	P9311		R-40A	
20003891	TP-365		P-3166	R-31A	T-26R00
20004283		P9738			
20004341				F-52X	T-21F60
20004771	TP-360	P9321	P-3059	R-33BC	T-26R19
20004811		F5529	P-3074	F-51X	
20004961			P-3166		
20005011		F5529		F-52X	T-21F60
20005012		F5529		F-52X	T-21F60
20005840		F5506†	P-3040†	F-7X	T-21F03
EMERSON					
730007	PH-40			F-30A	
730014			P-3059		
730014-1			P-3059*	R-20B & F-7X	
730018		P9731	P-3066	R-38BC	T-26R00
730022			P-3070	R-39B	T-26R21
730023		P9731	P-3063		T-26R00
730024		F5530	P-3097	F-50X	
730026	TP-392 & FO-63	P9731	P-3078	R-33BC & F-16X	T-26R00
730026-7		P9731	P-3067, 3074		
730029		P9731	P-3078	R-38BC & F-16X	T-26R00
730031	TP-370 & FO-63	P9731	P-3078	R-38BC & F-16X	T-26R00
730032		P9737	P-3076, 3074		
FADA					
42.12	TP-365	P9721	P-3061	R-31BC	T-26R00
42.58	TP-356	P9727	P-3059	R-37BC	T-26R00
42.61	TP-360	P9727	P-3067*	R-36BC	
Models S4C20, S4C40, S4T15, S4T30	TP-370*		P-3077, 3074		T-26R31
GENERAL ELECTRIC					
RTF-002		F5529	P-2944		
RTP-035			P-3076, 2944	R-42BC	T-26R25U
RTP-062				R-35BC & F-16X	T-26R00
RTP-066		P9723	P-3066	R-50BC	
RTP-300		P9723	P-3066	R-50BC	
HALLICRAFTERS					
52-170	TP-410**	P9731	P-3169	R-35BC	T-26R19
52C170	TP-410**	P9731	P-3169	R-35BC	T-26R19
52C170-2	TP-410**	P9731	P-3169	R-33A	T-26R19
52C185	TP-225**	P9702	P-3169†	R-42A	TV-24R98

*Add Series Resistor to Reduce "B+" Voltage. † Drill New Mounting Holes.
** Use Universal Mounting Brackets.

(*Continued on page* 148)

TRANSISTOR BAND SPOTTER

By PETER G. SULZER, W3HFW



Notice that the transistor band spotter has no power cord and needs no ventilation holes. The terminal posts, potentiometer, lettering, etc., give an idea of its size.

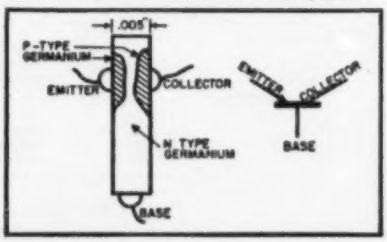
Any amateur can now have a transistor frequency standard at low cost. Simple, stable, with no warmup drift, this unit runs continuously off its internal flashlight cell.

THE availability of "*p-n-p*" junction transistors[1] has opened many interesting possibilities in the field of compact test equipment. One example of such equipment is the small frequency standard to be described here. Although compactness is in itself a virtue in the crowded ham shack or service shop, the low power consumption of the transistor provides an additional benefit, of value in the fixed station as well as for portable operation.

Consider a typical a.c.-powered frequency standard used for locating band edges, calibrating receivers and v.f.o.'s, and for checking service-type signal generators. It contains a rectifier tube, a 100-kc. crystal oscillator, and perhaps a multivibrator to produce markers at 10-kc. intervals. It consumes about 30 watts, and runs hot because it is built in a small box. As a result, its frequency drifts as it warms up, and its multivibrator may have to be readjusted to compensate for circuit-element changes during the heating cycle. A better design with a sufficient provision for heat dissipation would improve matters, but a crystal oven would really be necessary to complete the job of stabilizing the oscillator. Unfortunately, however, the equipment, and particularly the crystal oven, would have to be in operation at all times to avoid the warmup problem which would run up the power bill and constitute a fire hazard.

Here is where the additional benefit of the low-powered transistor comes in. The total power required by the band spotter is 300 microwatts, 1.5 volts at 200 microamperes. This is so small that a single flashlight cell should operate the unit for years, and therefore an "on-off" switch is not required. Since the band spotter operates at all times there is no warmup problem, and an accurate frequency calibration is available at all times, particularly if there is no hot equipment nearby. An additional point worth mentioning is the lack of a power cord to add to that ever-growing "tree" at the power outlet.

Fig. 1. Cross-sectional representation of a "p-n-p" transistor, used in this circuit, and standard transistor diagram symbol.



The band spotter contains a 100-kc. crystal oscillator and a 10-kc. synchronized blocking oscillator, each using a "*p-n-p*" junction transistor. Two outputs are provided at 100 kc.: a clipped sine wave at Terminal 1, which provides usable receiver-calibration markers up to 30 mc., and a sine wave at Terminal 2 for oscilloscope frequency comparison. The 10-kc. output at Terminal 3 is a 1-microsecond pulse having strong harmonics beyond 30 megacycles.

The "P-N-P" Transistor

In order to discuss the circuits used in the band spotter, a brief and much simplified description of the "*p-n-p*" junction transistor[2] is in order. This type of transistor contains a small (0.08 inch by 0.12 inch by 0.005 inch thick) wafer of "*n*"-type germanium. It will be recalled that most of the conduction in an "*n*"-type semiconductor takes place *via* electron flow, in contrast to the "*p*"-type, in which conduction effects occur through the flow of holes (places where electrons are missing in the crystal structure). A small dot of indium is placed on the two opposite flats of the wafer, which is then heated, permitting a portion of the indium to diffuse into the germanium. In this manner the diffused portions of the germanium are converted to the "*p*"-type. The heating process is continued until the thickness of the remaining "*n*"-type germanium at the wafer center is small, perhaps 0.001 inch, as shown in the drawing. Small wires are soldered to the dots, which become the emitter and collector connections and a third wire is soldered to one end of the wafer, which is the base connection.

Suppose, now, that the collector is made negative with respect to the base. A very small current will flow because of the direction of the electric field across the "*p-n*" junction. Here the negative charge on the collector will tend to repel electrons back into the "*n*"-type base, while the positive

charge on the base will repel holes (which behave something like positive charges) back into the collector. A similar situation would exist in an imaginary vacuum tube containing an electron emitter at its cathode and a positive-ion emitter at its anode. With the anode negative with respect to the cathode, cathode-current cut-off would occur because the electrons would be repelled back toward the cathode, and anode cut-off would occur because positive ions would be repelled back toward the anode. Since cathode current must flow through the anode, and *vice versa*, cut-off in a double sense is obtained.

If, while keeping the collector negative, the emitter is made slightly positive with respect to the base, a heavy emitter current will flow as electrons are drawn out of the "*n*"-type base by the positively-charged emitter, and holes are drawn out of the "*p*"-type emitter by the negatively charged base. It is seen, therefore, that the emitter behaves as a rectifier biased in the conducting direction, while the collector behaves as a rectifier biased in the non-conducting direction, and therefore the emitter has a low dynamic (a.c.) resistance, and the collector has a high dynamic resistance. However, according to this simple theory most of the holes drawn out of the emitter can pass right through the thin base region, and they will do so because they behave as positive charges, and are accelerated by the negatively-biased collector. These holes then constitute the collector current, which is almost independent of the collector voltage as long as the collector is negative. This is another way of saying that the collector dynamic resistance is very high.

It is not immediately apparent that such a device will amplify, but it does, and this is because of the large ratio of collector impedance to emitter impedance. If a small a.c. voltage is applied between the emitter and base, an alternating emitter current will be produced and, in a good transistor, most of this current will pass through the base and appear across a much higher impedance in the collector circuit producing a comparatively high voltage between the collector and base.

To consider some typical figures, suppose that the input (emitter-base) dynamic resistance is 100 ohms, the output (collector-base) dynamic resistance is 100,000 ohms, and suppose that 95% of the emitter signal current appears in the collector circuit (α, the short-circuit current gain = 0.95). Suppose, also, that a 100,000-ohm collector load resistance is used. If a 0.1-volt a.c. signal is applied to the emitter, the emitter signal current will be 1 milliampere, and therefore the collector signal current will be 0.95 milliampere. One half of this will go to ground through the collector dynamic resistance, while the other half will produce a useful signal of 47.5 volts across the 100,000-ohm load.

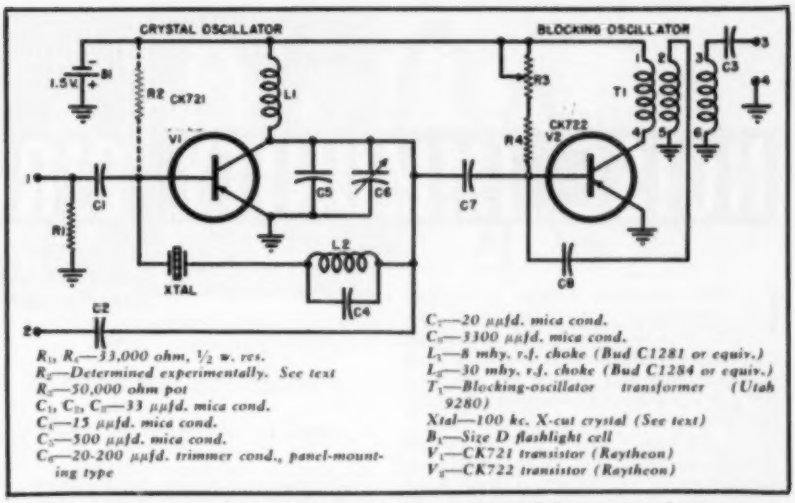


Fig. 2. The schematic shows the remarkable simplicity of the transistor frequency standard. R_2 is used if the measured current through L_1 is less than the normal value (see text). C_6, a trimmer, is the final front-panel adjustment. The economy of parts more than offsets the "expense" of using transistors rather than tubes.

The voltage gain is thus 475, a very substantial figure.

It has been seen, then, that the grounded-base connection can produce a large voltage gain at the expense of a very low input impedance. A more useful amplifier is obtained if the emitter is grounded, so that the base can be driven.[3] Since most of the current leaving the emitter passes through the base to the collector, the base current itself is much smaller than the emitter current. Consequently the base-driven circuit can produce a current gain as well as a voltage gain, and a much more versatile amplifier of higher input impedance is obtained. The current gain, which depends critically upon the value of α, may be 10 or more, while typical values for the input and output impedance are 1000 ohms and 100,000 ohms respectively.

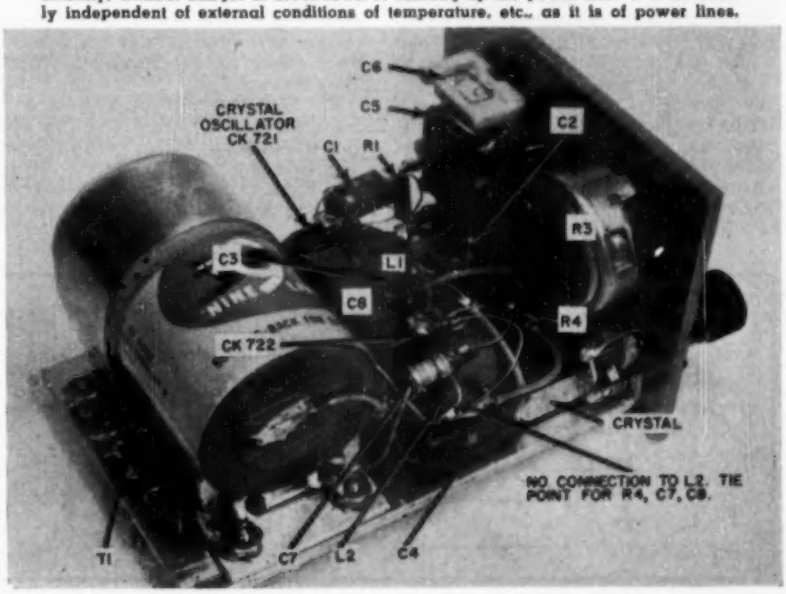
It should be pointed out that the base-driven connection produces a phase reversal, as does the grounded-cathode vacuum tube. In fact, the properties of a small voltage-amplifier pentode with a resistance on the order of 1000 ohms connected between grid and cathode resemble those of the base-driven transistor, although the transistor will operate with a much smaller power supply.

The base-driven connection is used in the crystal oscillator and blocking oscillator in the band spotter.

Considering the crystal oscillator, one might be tempted to "borrow" the

(*Continued on page* 126)

This internal view shows that the construction, while compact, is "roomy." There is no chance of overheating; the unit is left running continuously for its maximum stability, without danger of breakdown or running up the power bill. It is as nearly independent of external conditions of temperature, etc., as it is of power lines.



NOISE IMMUNITY CIRCUITS

By MILTON S. KIVER
Pres., Television Communications Institute

Part 2. The operation of more noise suppression circuits used in modern TV receivers for better sync and picture.

IN THE previous article, a number of television noise immunity circuits was described. It was noted there that while noise pulses may have only a momentary disturbing effect on the picture elements, they can be particularly destructive to the receiver's sweep systems, causing picture roll or picture break-up. It is to avoid this annoyance to the observer that noise immunity circuits are employed. In this article, a number of additional approaches to this problem will be examined.

The use of a noise gate placed in the path of the signal is one approach taken by *Philco* to minimize the effect of noise pulses on the sweep systems. A portion of the composite signal is taken from the plate of the first video amplifier and applied to a cathode follower. See Fig. 1. This stage is labeled as the first sync separator and it represents the first step in the separation process. In the signal applied to this tube, the sync pulses are positive. Now, the cathode resistor of this tube possesses the high value of 10,000 ohms, which means that the tube is operating quite close to cut-off. The sync pulses and portions of the video signals near the sync level will cause current to flow through the tube and hence this portion of the signal will pass through the stage. The more negative portions of the signal, however, will drive the tube into cut-off and these will be eliminated.

Since V_1 is a cathode follower, the output signal is taken from the cathode and transferred to the next stage which is a noise gate. This noise gate is diode connected and is in series with the path of the signal. As long as the diode conducts, signals from V_1 will reach V_2. However, should the diode cease conducting, the signal path is effectively opened and all signal flow ceases.

Examination of the diode circuit reveals that a voltage divider, formed by R_{606} and R_{607}, places a positive voltage of approximately 7 volts at the plate of V_2. The sync signal from V_1 also possesses a positive polarity and it is applied to the cathode of the diode. As long as the cathode positive voltage is less positive than the plate voltage (as it is for all normal signals), the diode will conduct. However, when a noise signal greater than the sync signal is received, the diode cathode is driven more positive than the plate. This cuts the diode off, preventing the noise from reaching V_3 and the sweep oscillators beyond.

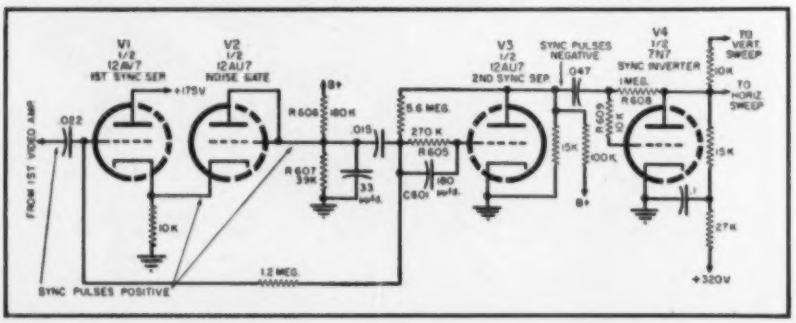
In order to make the diode effective over a wide range of incoming signal amplitudes, its plate voltage should change as the signal level varies. This is done in this system by connecting R_{606} to the end of a resistor (not shown here) which also supplies "B+" to the video i.f. amplifiers. As in a previous circuit (Part 1), the a.g.c. level will vary with signal strength and this, in turn, will vary the amount of current drawn by the controlled i.f. stages. The current, passing through the i.f. plate supply resistor, will change the voltage drop across that resistor and the positive voltage applied to V_2 will likewise vary.

The next stage in this system is V_3, the second sync separator. The sync pulses reaching V_3 are still positive since the noise gate diode did not invert them. V_3 is grid-leak biased, developing a biasing voltage across R_{608} and C_{601}, which is established by the level of the sync tips. The remaining video signal is ineffective in producing plate current and it is therefore substantially eliminated.

The sync pulses are amplified and inverted by V_3 and then transferred to V_4. This stage is inserted for the purpose of changing the negative sync pulses to positive polarity so that they will be in position to trigger the vertical and horizontal sweep oscillators. At the same time, this stage also functions as an amplifier and serves to remove any video signal that might still be present at this point. It accomplishes this latter job by the way the tube is biased. A one-megohm resistor, R_{608}, is connected between plate and grid, applying a small positive voltage to the grid. The resulting grid current, flowing through R_{608} and R_{609}, brings the actual grid potential (with respect to ground) to zero or close to it. (Here the voltage is slightly negative).

The tube under these conditions is operating close to saturation and any further positive voltage applied to the grid (by the signal, say) would not cause much change in plate current. This, in effect, prevents such positive (or relatively positive) signals from passing through the tube. However, when the negative sync pulses are active, the current through the tube is decreased. This change raises the tube's plate voltage, producing a positive sync pulse at the output of V_4. By this method a fairly clean sync pulse is presented to the vertical and horizontal sweep systems.

Fig. 1. Philco's noise immunity circuit using a diode-connected gating tube.



Multi-Element Tubes

Since the primary objective of a noise immunity circuit is to prevent noise pulses from affecting the operation of the sweep oscillators, most noise immunity circuits work closely with the stages just prior to the sweep oscillators. These, of course, are the sync separators. Multi-element tubes have also been drawn into the battle against noise pulses and the circuit of Fig. 2 is one example of how such tubes are employed.

The composite video signal with the

sync pulses negative is applied to the sync amplifier. This stage amplifies and inverts the signal so that at the output the sync pulses will extend in the positive direction.

This signal is now fed to grid 3 of the 6BE6 sync separator. The cathode of this tube is grounded and initially, grid 3 has zero bias on it. However, upon application of the signal, grid current is drawn on the positive sync tips, charging C_{611} to a negative potential. The discharge path for C_{611} is down through R_{609}, R_{610}, and R_{611}, with the result that grid 3 has a negative grid-leak bias developed in its circuit. The value of this bias is dependent upon the amplitude of the incoming positive sync pulses.

This arrangement works in the same way that it has in previously described circuits. The tube is brought out of cut-off only when the sync pulses are active and the tube drops back into cut-off when the rest of the video signal appears. The separation of sync pulse from the video signal is fairly clean cut with perhaps only a small amount of video signal passing through. It is generally difficult to effect a complete separation with only one sync separator stage, but even substantial separation is effective enough.

If the tube operated solely in this manner, there would be no protection against strong noise pulses since these could overcome the grid-leak bias and force tube current to flow. The real noise protection stems from grid 1 of the tube. Grid 1 connects to the video second detector, receiving a portion of the composite signal. In addition, a small positive voltage is applied to grid 1. Because of the presence of the series limiting resistor, R_{614}, the grid potential is maintained very close to zero. (Grid current flowing through R_{614} develops a negative voltage here which is approximately equal to the applied positive potential. This results in a grid 1 voltage close to zero.)

Now, the video signal that grid 1 receives has the sync pulses extending in the negative direction. The rest of the video signal is more positive, but it does *not* affect the plate current flowing through the 6BE6 because these positive components cannot raise the grid 1 potential above zero. (As the grid becomes positive, grid current increases, the potential drop across R_{614} follows suit and the voltage increase is counteracted. Basically then, the positive video components of the signal are without effect on grid 1.)

Now consider what happens when a strong noise pulse appears. Since this extends beyond the sync pulse, it will drive grid 1 strongly negative, completely cutting off the flow of plate current through the tube. Hence, at this instant, nothing appears at the output of the 6BE6 and the undesirable effect of the noise pulse is prevented from reaching the sweep circuits.

The stage beyond the 6BE6 serves to invert the negative sync pulses to enable them to trigger the subsequent sweep oscillators.

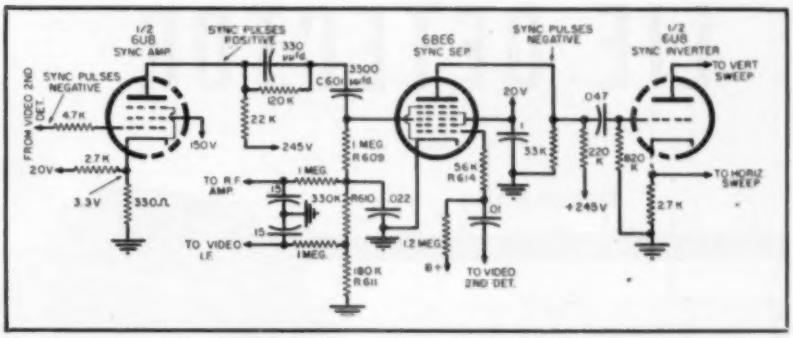


Fig. 2. Circuit using a 6BE6 multi-element tube for noise suppression.

Before we leave the 6BE6 it might be of interest to note that the a.g.c. voltage is developed in the grid 3 circuit. As stated previously, the level of the voltage developed in this circuit depends upon the amplitude of the arriving sync pulses. When the pulses are strong, the negative a.g.c. voltage rises; when the pulses are weak, the a.g.c. voltage is likewise small. By tapping off at appropriate points on the voltage divider network in the grid 3 circuit, the proper amount of controlling a.g.c. voltage can be obtained for the video i.f. and for the r.f. stages.

Keyed Noise Limiter

Stromberg-Carlson uses a noise limiter which is keyed or triggered by pulses from the horizontal output transformer. The circuit is shown in Fig. 3 and the manner in which it operates is as follows: A portion of the composite video signal is applied to the grid of the noise limiter at the same time that it is applied to the grid of the sync separator. The plate lead of the noise limiter is connected to the horizontal output transformer and current will flow through the tube whenever the plate is pulsed positively (during horizontal retrace) and the sync pulses are active at the grid of the tube. At these times, the current through the tube will charge up the cathode condenser C_1 to the peak value of the sync pulse. During the interval between sync pulses C_1 will discharge through R_1 and the plate resistance of the video amplifier. However, the time constant of this network is relatively long and the charge across C_1 will be only slightly decreased before the next sync pulse comes along.

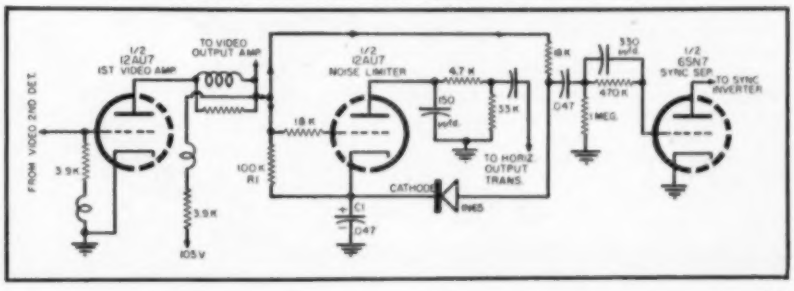
The cathode terminal on the germanium crystal diode is connected to the top end of C_1 and so this electrode has a positive potential equal to the voltage across C_1. In order for the crystal diode to conduct, therefore, its plate must be given a greater positive voltage. With ordinary sync pulses this will not occur and hence these sync pulses will reach the grid of the sync separator. However, when a noise pulse comes along with a potential more positive than that of the sync pulses, the crystal diode will conduct, effectively reducing the amplitude of the pulse as far as its effect on the sync separator is concerned. This additional noise charge is absorbed by C_1, but it does not ordinarily raise the potential of C_1 very much because of the size of this condenser and the relatively long time constant of the network.

Note, then, that much of the noise immunity of this circuit is dependent upon C_1 and the charge it possesses. It is the function of the noise limiter to keep C_1 charged to the normal level of the incoming sync pulse. Whenever a noise pulse stronger than the sync pulses arrives, the crystal diode conducts and effectively prevents it from disturbing the sync separator and the circuits that follow. The circuit is also designed so that the charge on C_1 will ordinarily not be appreciably affected by strong noise pulses. This can usually be counted on because noise pulses are of extremely short duration containing little average energy. C_1 scarcely starts to charge before the noise pulse ends.

Since the charge on C_1 is dependent upon the level of the incoming sync pulses, its average voltage will vary with the strength of the incoming sig-

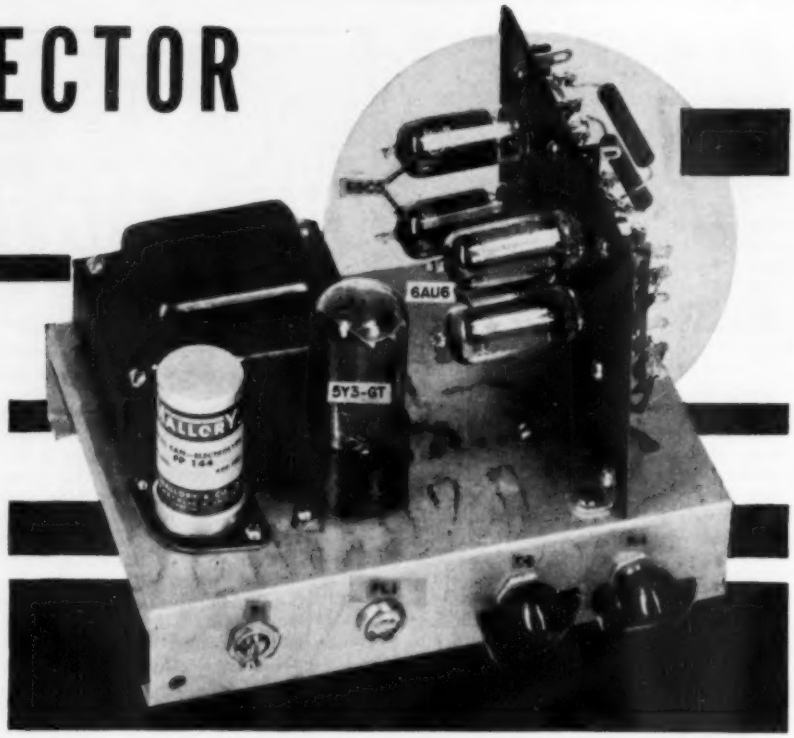
(Continued on page 113)

Fig. 3. A keyed limiter circuit with crystal diode to shunt out noise.



LIE DETECTOR

By
EDWIN BOHR



Over-all view of the home-built lie detector. Skin resistance changes are measured.

An easily-built instrument which measures changes in skin resistance—indicating whether or not subject is lying.

EVERYONE can probably think of a few choice uses for a "lie detector." These uses may have a humorous twist—a lie detector is fine for parties—or they may have a more serious application. Whatever the purpose, this lie detector is the genuine article. It is not just another toy.

Our emotions greatly affect the physiological function of our bodies. Some of these effects can be quite drastic. We have all heard of people being "scared stiff" from fright. However, there are other, more subtle changes that can be measured and used to indicate mental tension. To improve their validity, commercial detection units measure and record simultaneously several types of change. Increased emotional tension, for example, is accompanied by increased blood pressure. Changes in the skin's electrical resistance also accompany emotional strain. This change in skin resistance is used to indicate a "lie" in the unit to be described.

Detector Circuit

The lie detector circuit is a resistance bridge followed by a balanced d.c. amplifier. There are several reasons for using the balanced (push-pull) d.c. amplifier circuit. For one thing, the balanced amplifier does not need the complicated voltage regulator tube circuits and divider networks required by single-ended amplifiers.

Secondly, the balanced amplifier is inherently more immune to fluctuations in heater and plate supply voltages. Finally, the balanced circuit, as we planned it, would need no initial adjustments to place each tube within its proper operating range. In this respect, the amplifier is self-compensating. You build it and it works—no fuss, no muss.

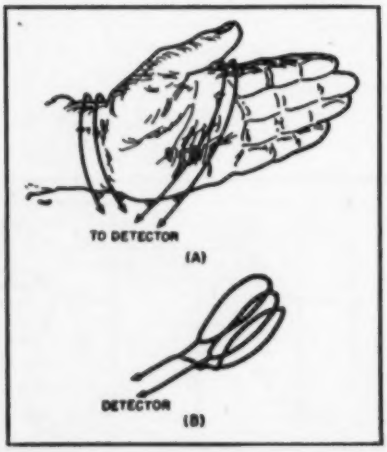
A simple resistance bridge precedes the amplifier. Two variable resistors (coarse and fine) are used to "balance out" the resistance of the person to whom the detector is connected. A closed circuit jack inserts a substitute resistance in the circuit whenever the electrode plug is removed. This maintains a reasonable circuit balance and provides a standard resistance against which to check the circuit when the plug is pulled.

A small 15-volt hearing-aid battery supplies the voltage for the bridge. This voltage could probably be tapped from the plate supply. We used the battery (it is stable and reliable) in preliminary experiments with the detector, so it was included in the final version. The drain on the battery is small, only about .06 milliamp, and the power switch removes even this load when the unit is turned off.

The bridge places a positive bias on the control grids of the first two amplifier tubes. This is compensated for by the higher-than-usual common cathode resistor (R_7 in the diagram).

A balanced signal is not fed to the 6AU6 grids from the bridge. Nevertheless, a balanced condition is achieved by virtue of the voltage developed across R_7. To illustrate this action let's take a specific example.

Fig. 1. (A) How electrode is connected to the subject. (B) Closeup view of electrode unit.



Suppose the person undergoing a detector test has a lowered skin resistance as a result of telling a lie. By looking at the bridge diagram, we see that this lowers the positive bias on V_2. Thus it constitutes a negative signal swing. Since the V_1 side of the bridge has experienced no resistance change, there is no signal applied to the grid of V_1. However, as the grid of V_2 swings negative, the cathodes of V_2 and V_1 also swing negative since the plate current of V_2 decreases. This makes the grid of V_1 more positive with respect to its cathode—the equivalent of applying a positive signal swing to V_2. This same circuit is often found in oscilloscopes.

Both screen grids are fed from a single dropping resistor. As the screen current increases in one side of the circuit, it decreases in the other side, maintaining the screens at essentially the same voltage during signal variations. This gives a bypassing effect down to "zero cycles." In single-ended circuits, VR tubes must be used for bypassing.

Each 6BC5 control grid is direct-coupled to the plate of the preceding 6AU6. This places the grids more than 100 volts above ground. However, the

large positive bias developed across R_{11} places the grids negative with respect to their cathodes. The resistance of R_{11} is less than R_7 since each 6BC5 passes about 10 milliamps of current and each 6AU6 passes less than 1 milliamp of current.

Inspection will show the 6BC5 tubes, together with their load resistors, comprise another Wheatstone bridge. The tubes are the variable elements of the bridge. Any difference in potential between the plates of the two 6BC5 tubes will cause current to flow through the meter or indicating device.

The power supply requirements are very simple—about 325 volts at 30 milliamps. Very little filtering is necessary—a single filter condenser does the job. Incidentally, this is the only condenser in the entire lie detector unit.

Electrodes and Indicating Meter

The electrodes may be applied to the hand or to the arm just above the wrist. Generally speaking, the palm gives the greatest sensitivity, but movements of the hand are likely to unbalance the circuit. See Fig. 1. The larger the area of the contacts to the skin the greater will be the change in resistance with the telling of a lie.

It will be found that skin resistance varies considerably from person to person. The spacing between the electrode wires can be changed to accommodate this variation. If the resistance is unusually high, three loops can be used with the two outside loops paralleled (Fig. 1A) to maintain good sensitivity. The electrodes can be held on with small tabs of adhesive tape or sewn onto cloth bands equipped with "snappers" to make the size adjustable.

Moist breath, from as far as two feet away, will completely "peg" the indicating meter. This is one indication of just how sensitive the detector is. In fact, the amplifier is suitable for any supersensitive application—moisture content meters, comparison bridges, etc.

A five milliamp meter will serve as an indicating meter. We have used

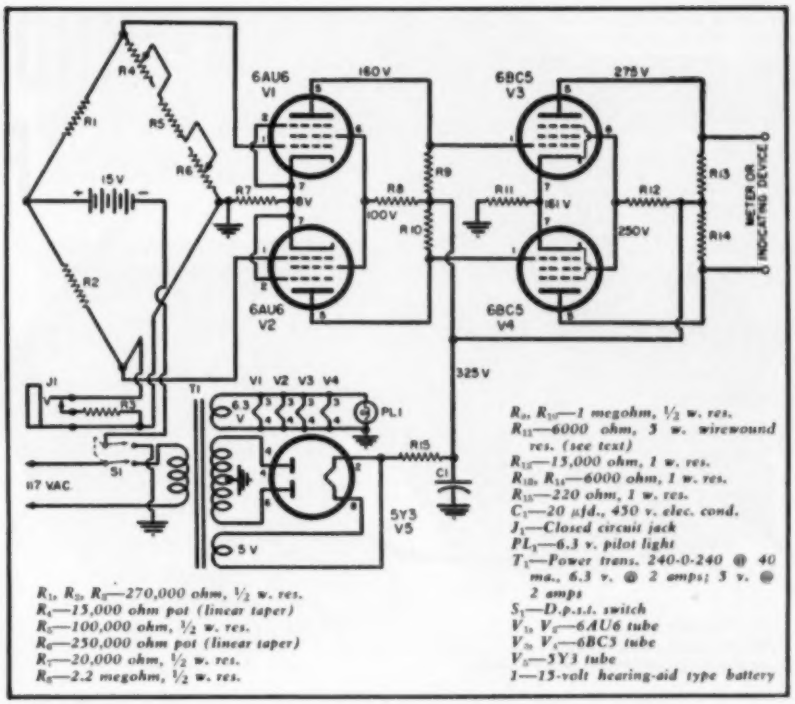


Fig. 2. The lie detector is a resistance bridge followed by a balanced d.c. amplifier.

everything from a 50 volt to a 100 microamp meter. Any multitester will do! The multitester range can be varied to change the sensitivity: A high range can be used for rough balancing and a more sensitive range for precise balancing and detection.

Of course, the ideal instrument would be a recording volt or milliamp meter. For demonstration groups we have used a portable mirror galvanometer to reflect a spot of light on the wall as an indicating means. The sensitivity was so great it was necessary to insert a 100,000 ohm rheostat in series with the galvanometer.

Operation

How accurately lies are detected depends upon the skill with which the questions are submitted and the interpretation placed upon the meter indications. Remember, the person undergoing the test must react emotionally to the question or words mentioned, otherwise the detector will give no indication.

For example, connect the detector to a friend who understands the nature of the experiment and start a normal conversation. Without warning, give him a sharp slap on the face. It will throw the meter off scale! Questions about trite situations will usually give questionable results. The detector can be very revealing without the person undergoing the test even answering. For example, we were reading a list of names and objects

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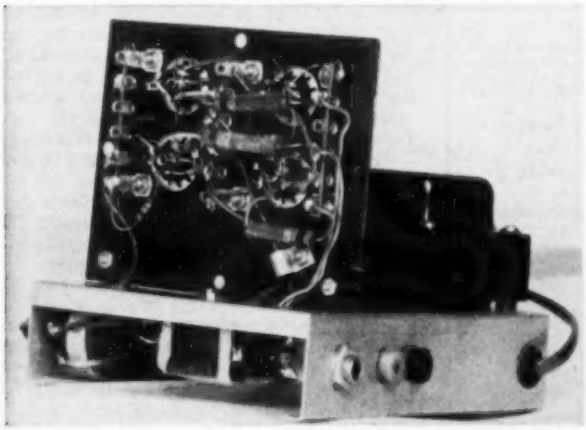
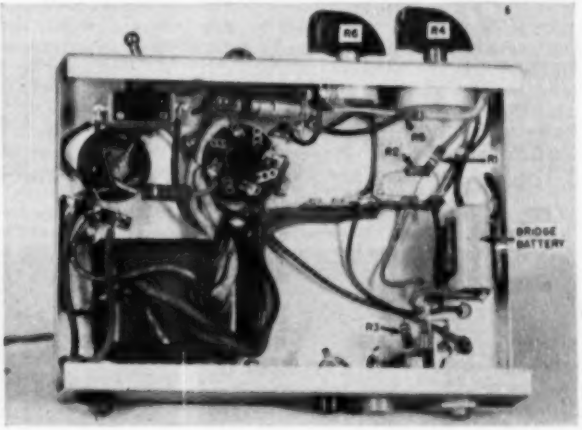
Rear view of lie detector showing sub-chassis mounting of tubes.

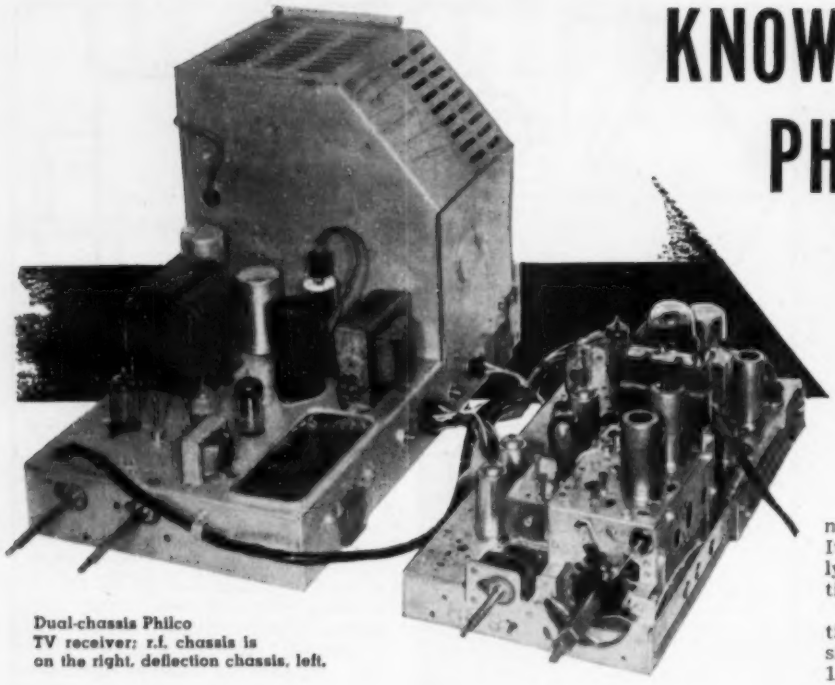


Under chassis view showing parts location in resistance bridge.



KNOW YOUR 1953 PHILCO TV RECEIVERS

By **DAN LERNER**
Philco Corporation



Dual-chassis Philco TV receiver; r.f. chassis is on the right, deflection chassis, left.

Circuit explanation and service data for the new Philco TV receivers, including the complete schematic diagram.

THE LATEST in the series of *Philco's* duplex line of TV receivers uses chassis containing some unique and interesting circuits. Although most of these new circuits are on the r.f. chassis, some will be found on the deflection chassis which drives a 27-inch picture tube, a 27LP4A. (See Fig. 7.) To simplify a discussion of the new circuits, they will be treated individually.

First let us look at the front end. (See Fig. 8.) The incoming signal is not applied directly to the 6BZ7 r.f. amplifier grid but, instead, is coupled through inductively. For this purpose a tapered line is used which matches the relatively low impedance of the antenna to the high impedance of the tube. Two traps are used in the tapered-line system—one, the i.f. trap, eliminates 40 mc. interference, and the other, FM interference around 100 mc. The tapered line provides a uniform match to the input grid at all v.h.f. frequencies.

The first section of the 6BZ7 serves to match the input system to the second section of the 6BZ7. The signal is coupled from the first section plate directly to the second section cathode. This section functions as a grounded-grid r.f. amplifier. The over-all r.f. stage with this arrangement has the gain of a well designed pentode r.f. amplifier with much superior noise figure.

A 12AZ7 is used as an oscillator and mixer. The output of the mixer at 40 mc. is fed through a low impedance system (link coupling) to the first i.f. stage.

A four stage video i.f. system with high gain 6CB6 tubes is used in these sets. (See Fig. 8). Transformer coupling is used throughout in order to obtain wide bandpass and freedom from interference. The average over-all bandpass in the i.f. system is 3.5 mc. at the 70% response point.

The A.G.C. System

The a.g.c. system used in the receiver is somewhat novel as far as normal *Philco* practice is concerned. It provides an a.g.c. voltage completely independent of the picture modulation and random noise insertion.

The a.g.c. gate tube, a 6AU6, functions in a keyed a.g.c. system. Picture signal of a certain amplitude, see Fig. 1, is obtained from the plate of the video amplifier, one-half of a 6U8, across R_{205}, a 4700-ohm resistor. This signal is fed to the control grid of the gate tube. A gating or keying pulse (Fig. 2) is obtained from the horizontal output transformer. This pulse, at a frequency of 15,750 cps, is applied to the noise gate plate. (See Fig. 7 for a.g.c. winding on flyback transformer.) It has an amplitude of about 500 volts peak-to-peak. Because of a large "B+" bias on the cathode of the a.g.c. tube, the plate is normally negative with respect to the cathode. Since the flyback pulse is generated only during retrace time, that is, horizontal sync and blanking time, the a.g.c. tube plate will be positive and, therefore, will be able to conduct only during this short time, about 10 microseconds. However, the tube will conduct in proportion to the amplitude of the positive sync pulse tips on its control grid and then only if the keying pulses occur at the same time as the sync pulses. Therefore, since the amplitude of the plate keying pulses is fixed, that is about 500 volts, the amplitude of the sync pulses on the control grid determines the amount of conduction in the gate tube. Since the a.g.c. gate tube conducts only during flyback time, noise disturbances that occur during any other time will have no appreciable effect on the a.g.c. voltage.

The plate current of the keyed a.g.c. tube develops a negative voltage in its plate load circuit which is used to control the receiver i.f. and r.f. gain.

Fig. 1. Signal from plate of video amplifier fed to a.g.c. tube control grid.

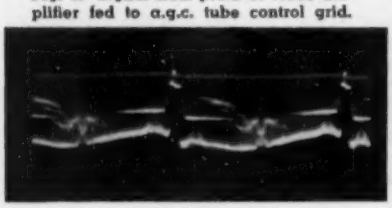
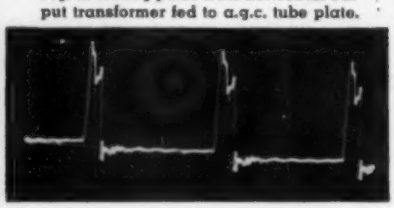


Fig. 2. Gating pulse from horizontal output transformer fed to a.g.c. tube plate.



The Sync System

Composite video for the sync system is taken from the plate circuit of the video amplifier. The voltage developed across R_{204} and R_{205} is fed to the grid of the noise inverter, ½ of a 12AU7,

and to the grid of the sync separator, ½ of a 6U8, through R_{166}. See Fig. 8. The noise inverter tube is operated as a modified clipper tube, that is, with a low level of plate voltage, about 34 v., and with a high negative grid voltage, 6.6 v. This keeps the tube normally operating beyond plate current cut-off.

When the composite video signal is applied to the grid of the noise inverter from the video amplifier, the sync signal is positive. Thus, any noise accompanying the sync signal will also appear positive. Most noise pulses have amplitudes far greater than that of the sync pulses. These, being highly positive, drive the inverter tube to conduction during the time of the noise pulse. To establish the proper bias on the noise inverter for a given signal level, so that the sync tips are just below cut-off, another tube called the gated leveler is used. The gated leveler conducts only when the gating pulses occur. Note that the grid of the leveler is tied back to the a.g.c. gate pulse source through condenser C_{169} and the divider R_{168}, and R_{167}. (See Fig. 6.) Plate current flows in the gated leveler when sync pulses from the video signal reach the plate through C_{161} at the same time that positive gating pulses reach the grid. This current flow through V_{14A} charges condenser C_{161} setting a bias on the grid of V_{14B}.

The output of the noise inverter consists of negative noise pulses. This is mixed with the picture signal and then fed to the grid of the sync separator. The noise present in the positive composite video signal fed to the sync separator is effectively cancelled out by the negative noise signal from the conducting noise inverter. (See Figs. 3 and 4.)

The Phase Comparator

The output of the sync separator (see Fig. 5) is fed to the phase splitter, ½ of a 12AU7. (See Fig. 7.) This tube provides two polarities of sync, a positive one at the plate, and a negative one at the cathode.

As can be seen from Figs. 9 and 10, the outputs from the phase splitters are of opposite polarity but of equal amplitude. The positive pulses are fed to the plate of one section of the phase comparator, V_{11A} on Fig. 7, and the negative pulses to the cathode of the second section. A part of the horizontal sweep output pulse (see Fig. 12), is taken from a special winding in the output transformer and fed to the plate of the second section and the cathode of the first section through a saw-tooth forming network, R_{117}—C_{162} (see Fig. 11A). In these tube sections the horizontal sync and sweep signals are compared. When the horizontal sweep and sync signals are in-phase, the current flow through the two diode sections is balanced; that is, the resulting voltage at the top of the plate divider resistor R_{166} is zero. When the two signals are out-of-phase in any manner, some difference voltage is developed across R_{166}. This reference point, that is, the top of R_{166}, is connected to the horizontal oscillator grid through the network of C_{163}, R_{164}, and C_{165}. If the reference point voltage is positive, it makes the oscillator come out of cut-off faster and thus increases its frequency. When the voltage is negative, it takes

(*Continued on page* 61)

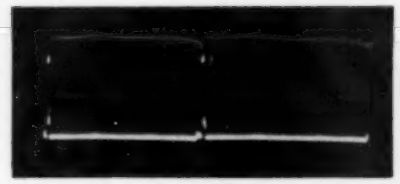


Fig. 3. Signal fed to the sync separator.

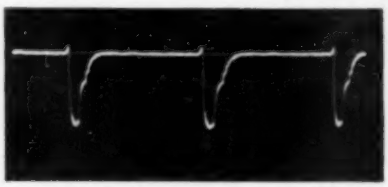


Fig. 4. Output from V_{17B} (scope 15,750 cps.).

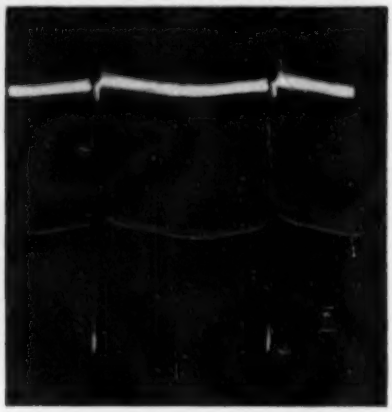


Fig. 5. Output from the plate of the sync separator shown with the scope at 60 cps.

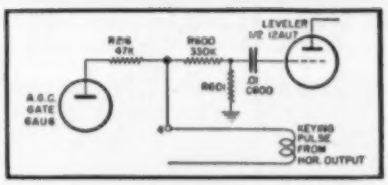
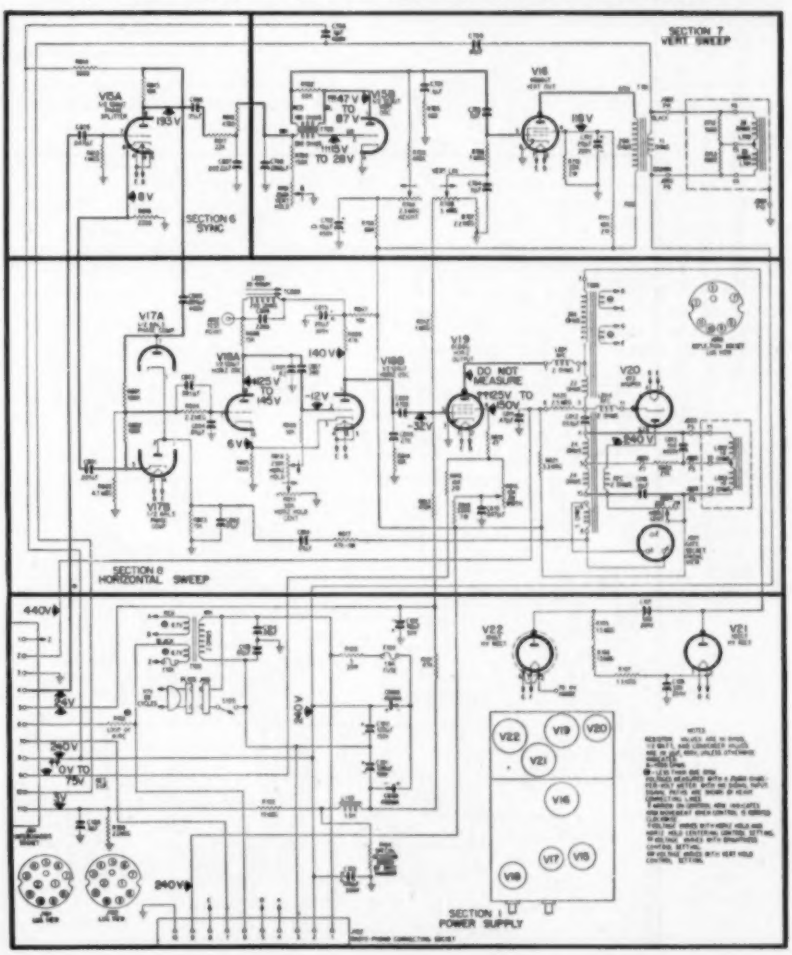


Fig. 6. Gated-leveler tube grid circuit.

Fig. 7. Schematic of the Philco deflection chassis, J-7, used in 1953 receivers.



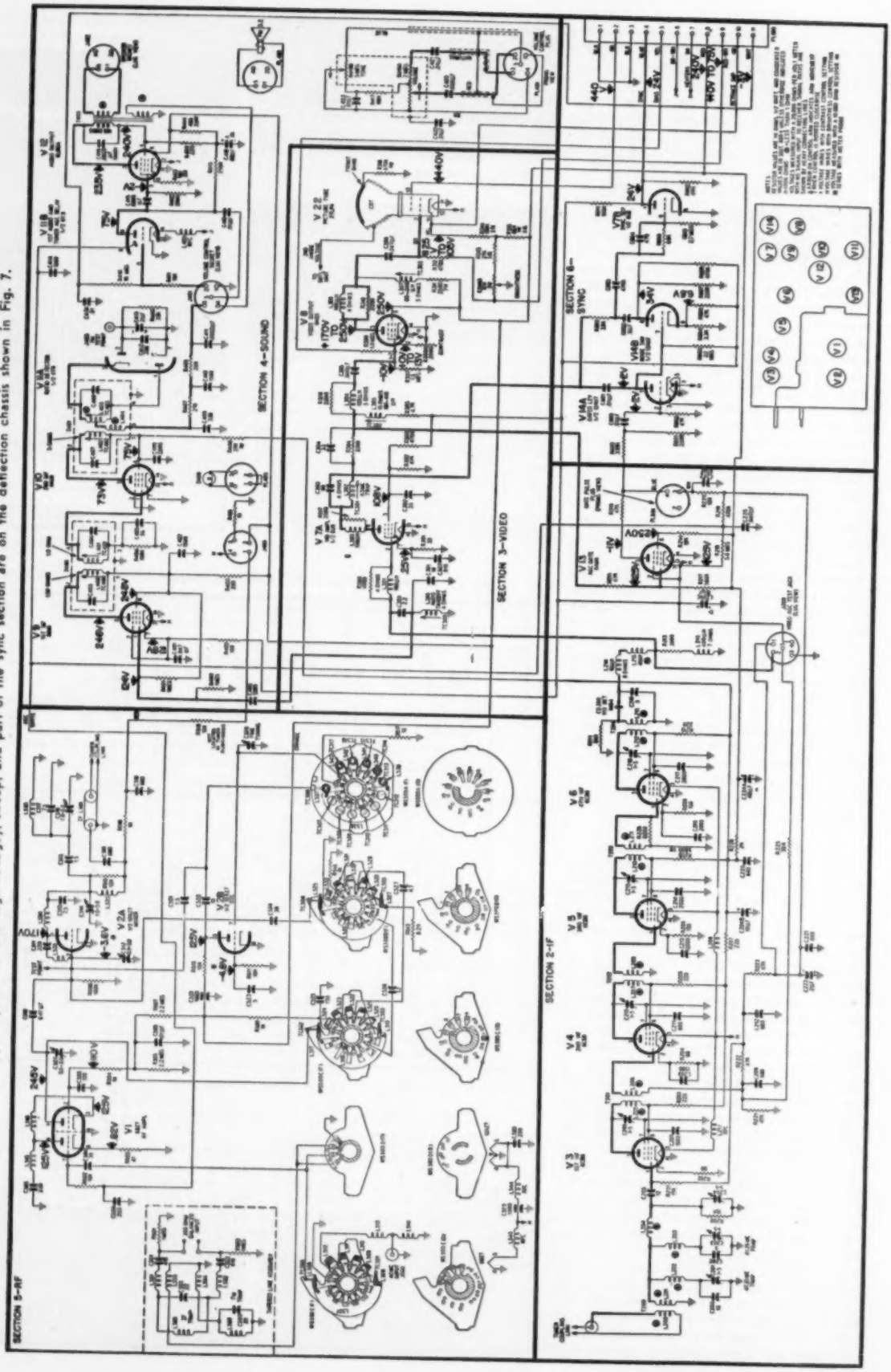


Fig. 8. Complete schematic diagram of the Philco TV r.f. chassis 97.

The r.f. chassis of this dual-chassis receiver contains the tuner, i.f., video, sound, and sync portions of the set. The power supplies (both low and high voltage), sweep, and part of the sync section are on the deflection chassis shown in Fig. 7.

longer for the oscillator to come out of cut-off and thus, the frequency is decreased. Therefore, the horizontal oscillator can be said to be frequency stabilized by the phase comparator action.

The horizontal oscillator and output circuit is conventional except for one feature. The output from the horizontal oscillator is fed to the grid of the output tube. (See Fig. 7.) The screen circuit of the 6CD6 output tube is unique in that the width and brightness controls are interacting. The screen is tied back to the brightness control through the 10,000 ohm resistor R_{316}. If the width control is varied so that the screen voltage is reduced, the plate current reduction will result in a corresponding width reduction. When the brightness control is advanced, the slight reduction in high voltage will cause the width to increase. The circuit arrangement is such that as the brightness control is advanced, the screen voltage of the horizontal output tube is reduced slightly and thus compensates for the width increase.

Special Service Techniques

Unstable horizontal sync: Since the phase comparator serves as a balanced phase circuit, any change in individual circuit components may cause unbalance and faulty action. The balanced phase comparator plate load resistors, R_{305}, R_{301}, and R_{307} are especially critical in this respect.

By using a test oscilloscope, the phase of the sync pulses at the plate and cathode may be checked. As was explained previously, they should be of opposite phase. It would be wise to change the .01 μfd. condenser C_{305} if the trouble appears in this circuit.

Extremely black picture, tearing: A test oscilloscope will save much time in troubleshooting the a.g.c. circuit, source of this trouble. Checks should be made at the grid and plate of the a.g.c. gate tube for proper waveform and amplitude.

Also check the action of the 1st sound i.f. amplifier since the a.g.c. gate derives its bias from the plate load resistor of the video amplifier in series with the 1st sound i.f. tube.

It should also be remembered that defects in the horizontal output circuit will affect the a.g.c. gate plate keying pulse and, thus, over-all a.g.c. operation.

Aligning the r.f. chassis: The most practical method for oscillator slug alignment is to utilize the station signals available. With this system it must be ascertained that the video i.f. strip is correctly aligned. To adjust the slugs, use the following method:

1. Turn the fine tuning control so that it is in the center of its range.

2. Tune in the highest frequency channel to be received and adjust the oscillator slug starting with sound in the picture and turning until the sound just disappears from the picture. (The video carrier i.f. set to the 50% point on the response curve.) Repeat this operation for all channels to be received.

(*Continued on page* 92)

Fig. 9. Positive sync signal from the plate of the phase splitter tube, V_{15A}.

Fig. 10. Negative sync signal from the cathode of the phase splitter.

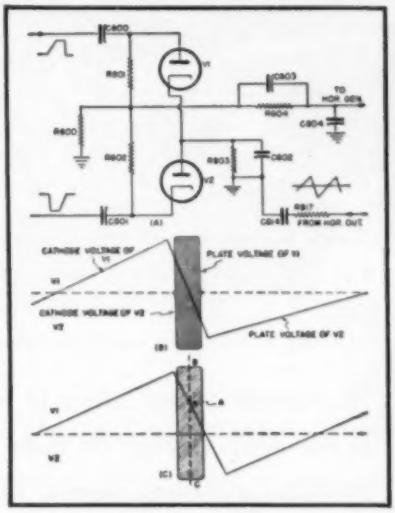


Fig. 11. (A) Simplified schematic of phase comparator circuit. (B) Horizontal oscillator and sync pulse in-phase. (C) Horizontal oscillator running fast.

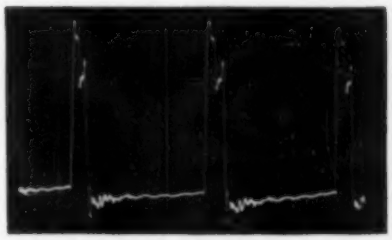


Fig. 12. Horizontal sweep output pulse from special output transformer winding.

Fig. 13. Waveshape of the voltage at the horizontal oscillator cathode. A similar (but inverted) waveshape at the plate is fed to the output tube grid.

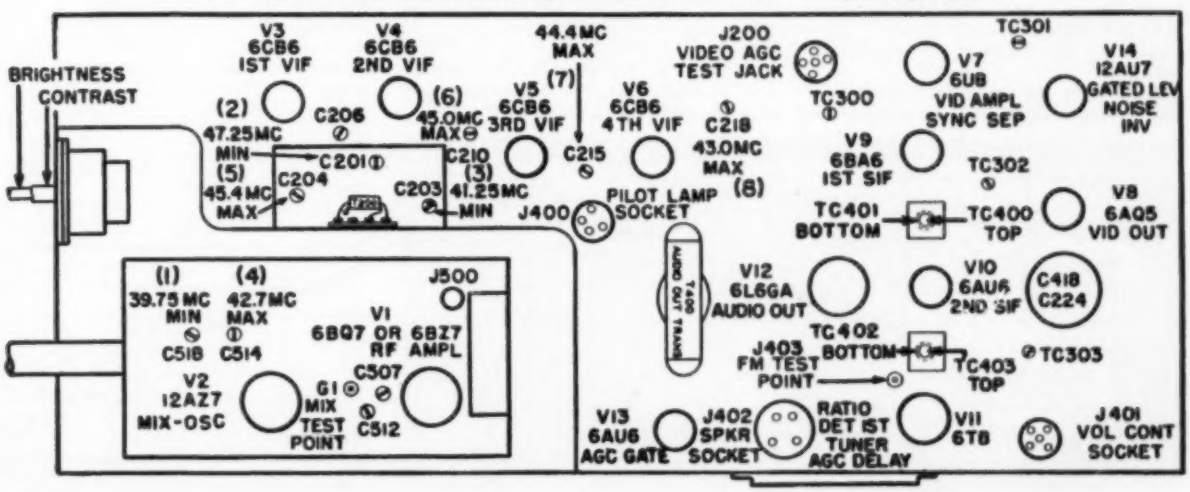


Fig. 14. Top view of the r.f. chassis showing trimmer locations and video i.f. alignment procedure.

THE FISHER MASTER AUDIO CONTROL

By

JOHN R. RUSSELL

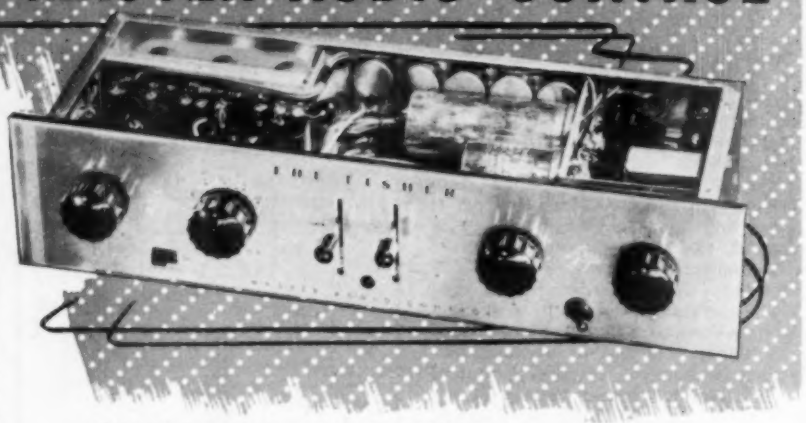


Fig. 1. Front panel view of the Fisher Model 50-C master audio control unit.

This analysis, and others to follow, is presented in response to the many requests for data on commercial hi-fidelity audio products including tuners, preamps, power amplifiers, test equipment, loudspeakers, and various types of enclosure units.

THE TREND in recent years has been to incorporate centralized audio control into circuitry embracing the selection of various circuits, and with the provision for complete equalization of all circuits included in one unit. The *Fisher* Model 50-C (Fig. 1) is typical of audio units now available having self-contained facilities for channel selection, tone control, and phono equalization. Besides possessing other features found in custom units, such as "Loudness Control," this equipment provides an extremely low hum level due, principally, to its use of triodes and a well-engineered power supply.

The circuit, Fig. 4, uses three dual-purpose tubes. One is utilized for phonograph and microphone preamplification in the main circuit. One-half of the 12AU7 is used as an input cathode follower to produce a low impedance source, both to the recorder output jack and to the loudness control. This is followed by one-half of the 12AX7 to provide voltage amplification. This stage operates with a comparatively low value of plate load resistor and is followed by the principal tone control circuits. The second half of the 12AX7 follows the tone circuits and provides additional voltage amplification. Distortion is greatly reduced by utilizing a degenerative circuit. The second section of the volume control follows this stage, and operates into the remaining half of the 12AU7 tube. This latter stage functions as a cathode follower to obtain low impedance output and to provide a low input loading to the volume control.

Relatively low impedances are used throughout the circuit to obtain the lowest possible noise level. Crosstalk is effectively eliminated by providing an additional section on the "Selector Switch" to short out unused inputs.

The phonograph preamplifier circuit comprises both halves of a second 12AX7 connected as a cascaded triode amplifier. Low frequency boost for proper record turnover is achieved with conventional *RC* networks. The turnover frequency is selected by switching various values of capacitance in the circuit. Conventional *RC* networks follow the second section of the 12AX7 to accomplish high frequency roll-off. This results in reduction of noise arising from the preamplifier tubes and their components. The circuit is so arranged that, by means of a simple wiring change, the microphone input can be converted to a second magnetic phonograph input.

Switching transients have been effectively reduced by proper design, and no "clicks" or "pops" are perceptible when either the "Selector" or "Equalization" switches are operated. Close tolerance components are used in all frequency-sensitive circuits to assure close adherence to published specifications. Extensive shielding and the use of a common ground bus, keep hum to an absolute minimum.

The 50-C control is completely self-contained (Figs. 1 and 6) and no external power supply facilities are required. Power is provided by a filtered bridge-type selenium rectifier which provides d.c. for all heaters. It also provides plate voltage using a full-wave selenium rectifier and a four-section *RC* filter. The entire unit draws but 15 watts.

Five inputs and five independent in-

Fig. 2. Bass and treble control range for the Model 50-C.

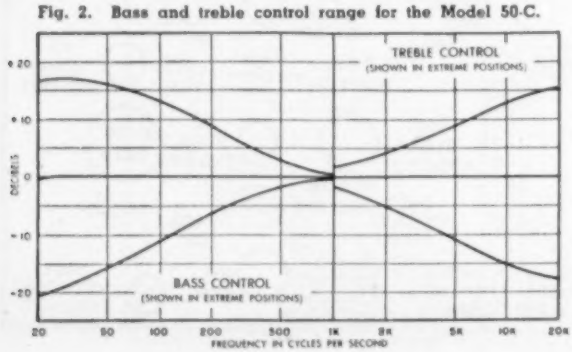
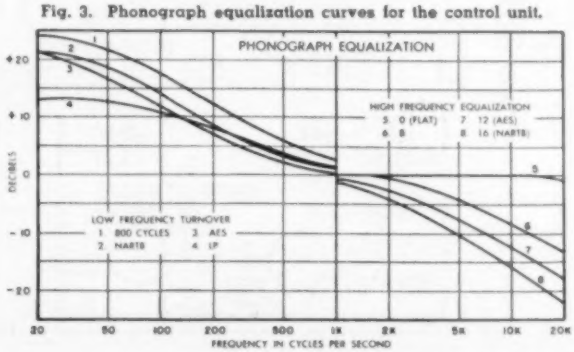
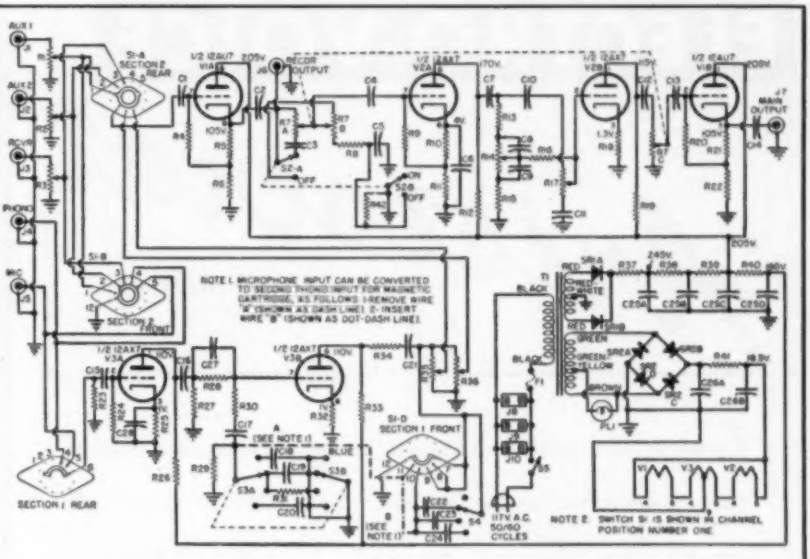


Fig. 3. Phonograph equalization curves for the control unit.



R_1, R_2, R_3, R_{32}, R_{36}—*500,000 ohm pot*
R_4—*1 megohm, ½ w. res.*
R_5, R_{17}—*2200 ohm, ½ w. res.*
R_6, R_{15}, R_{23}, R_{24}—*47,000 ohm, ½ w. res.*
R_{7A}, R_{7B}, R_{7C}—*Three-section pot (1 megohm, 100,000 ohms, 500,000 ohms)*
R_8, R_{13}, R_{37}—*10,000 ohm, ½ w. res.*
R_9, R_{31}, R_{35}, R_{42}—*1 megohm, ½ w. res.*
R_{10}, R_{25}, R_{28}—*1300 ohm, ½ w. res.*
R_{11}, R_{14}, R_{29}, R_{30}—*3300 ohm, ½ w. res.*
R_{12}, R_{39}—*39,000 ohm, ½ w. res.*
R_{14}, R_{33}—*1 megohm pot*
R_{16}, R_{26}, R_{38}—*100,000 ohm, ½ w. res.*
R_{18}, R_{41}—*220,000 ohm, ½ w. res.*
R_{20}, R_{21}, R_{27}—*2.2 megohm, ½ w. res.*
R_{22}—*18 megohm, ½ w. res.*
R_{34}—*47 ohm, ½ w. res.*
R_{43}—*15 ohm, 2 w. res.*
C_1, C_{13}, C_{18}—*.01 µfd., 400 v. cond.*
C_2, C_{14}, C_{17}, C_{23}—*.1 µfd., 400 v. cond.*
C_3—*82 µµfd., 500 v. cond.*
C_4, C_9, C_{15}, C_{16}—*.022 µfd., 400 v. cond.*
C_5—*.027 µfd., 400 v. cond.*
C_6—*.003 µfd., ceramic cond.*
C_7, C_{19}—*.047 µfd., 400 v. cond.*
C_8, C_{11}—*.0022 µfd., 400 v. cond.*
C_{10}—*220 µµfd., 500 v. ceramic cond.*
C_{12}—*.0082 µfd., 400 v. cond.*
C_{20}—*.0047 µfd., 400 v. cond.*
C_{22}—*420 µµfd., 500 v. ceramic cond.*
C_{24}—*800 µµfd., 500 v. ceramic cond.*
C_{24}—*.0013 µfd., 500 v. ceramic cond.*
C_{25A}, C_{25B}, C_{25C}, C_{25D}—*40 µfd., 300 v. elec. cond.*
C_{26A}, C_{26B}—*500 µfd., 25 v. elec. cond.*
C_{27}—*4.7 µµfd. ceramic cond.*
C_{28}—*25 µfd., 10 v. elec. cond.*
F_1—*3AG fuse, ½ amp.*
J_1, J_2, J_3, J_4, J_5, J_6, J_7—*Jack, 1 female contact*
J_8, J_9, J_{10}—*Outlet receptacles*
S_1—*4-pole, 5-pos. rotary sw.*


NOTE 1: MICROPHONE INPUT CAN BE CONVERTED TO SECOND PHONO INPUT FOR MAGNETIC CARTRIDGE, AS FOLLOWS: 1-REMOVE WIRE 'A' (SHOWN AS DASH LINE) 2-INSERT WIRE 'B' (SHOWN AS DOT-DASH LINE).
NOTE 2: SWITCH S1 IS SHOWN IN CHANNEL POSITION NUMBER ONE.
117 V A.C. 50/60 CYCLES
SECTION 1 REAR
SECTION 2 FRONT
SECTION 1 FRONT
SECTION 2 REAR

S_2—*D.p.d.t. slide sw.*
S_3—*D.p. 4-pos. lever sw.*
S_4—*S.p. 4-pos. lever sw.*
S_5—*S.p.s.t. toggle sw.*
SR_{1A}, SR_{1B}—*High-voltage, full-wave selenium rectifier, 240 volts d.c. output @ 10 ma. (Radio Receptor 24Y3)*
SR_{2A}, SR_{2B}, SR_{2C}, SR_{2D}—*Bridge-type filament selenium rectifier, 20 volts d.c. output @ .3 amp.*
PL_1—*3 v. or 6.3 v. pilot lamp*
T_1—*Power trans. 200-0-200 v. @ 10 ma.; 20 v. @ 300 ma., tapped at 5 v. (Fisher Part No. T505-115)*

Fig. 4. Complete circuit diagram of the Fisher Model 50-C "Master Audio Control."

put level controls are available by means of the "Selector Switch." The input level controls perform the further function of permitting correct level settings for proper performance of the "Loudness Control."

Two output channels are provided. Both of these employ cathode-follower circuitry. The "Main Output" can be connected to any amplifier having an input impedance of 100,000 ohms or greater. Because of the low internal impedance of this output circuit, the connecting cable length will not be critical and runs up to 200 feet may be used. The same condition would apply to the "Recorder Output." The latter circuit is taken preceding all tone controls and is used to furnish a signal to a tape or wire recorder. It also provides simultaneous monitoring from the "Main Output."

Panel Controls

1. *Volume Control.* All essential controls are mounted conveniently on an etched panel to facilitate the operator's job. They include a three-section volume control incorporating the loudness control compensation facilities. This compensation is based on the Fletcher-Munson curves.

2. *Loudness Control Switch.* This control will be found adjacent to the volume control. In the "Off" position, the volume control becomes a two-section gain control.

3. *Selector Switch.* This has five positions, including two auxiliary inputs plus receiver, phonograph, and microphone settings. This arrangement thus provides a common central switching point for the entire system.

4. *Bass and Treble Tone Controls.* The mid-range position of these controls provides an essentially flat response. Up to 16 db of cut or boost are provided at approximately 50 and 10,000 cycles respectively. See Fig. 2.

5. *"On-Off" Switch.* The capacity of the switch is 6 amperes. The handling capacity is sufficient to take care of the normal requirements of a conventional audio system. Three auxiliary a.c. receptacles are provided and are all operated by the "Control Switch."

6. *Phonograph Equalization Switches.* Separate lever-type switches are included for both bass and treble equalization and each is provided with four distinct positions. The bass provides turnover frequencies for AES, NARTB, LP, and 800 cycles. The treble switch includes 0 db, 8 db, AES, and NARTB roll-off points. Thus there are sixteen possible combinations for full equalization. Fig. 3.

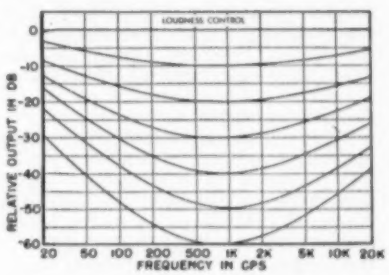


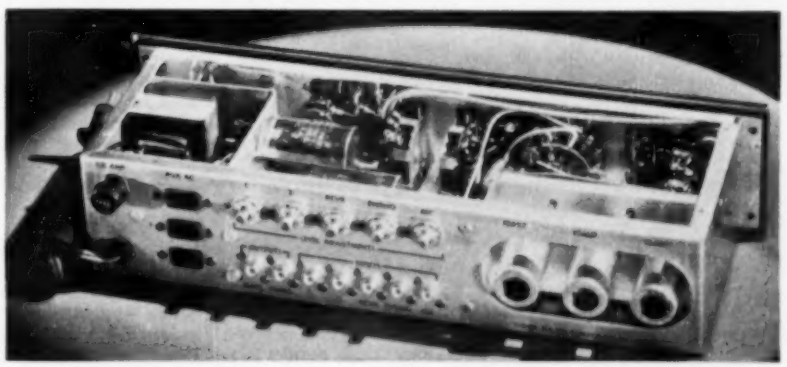
Fig. 5. Loudness control curves of unit.

Specifications

Specifications on the Model 50-C include:

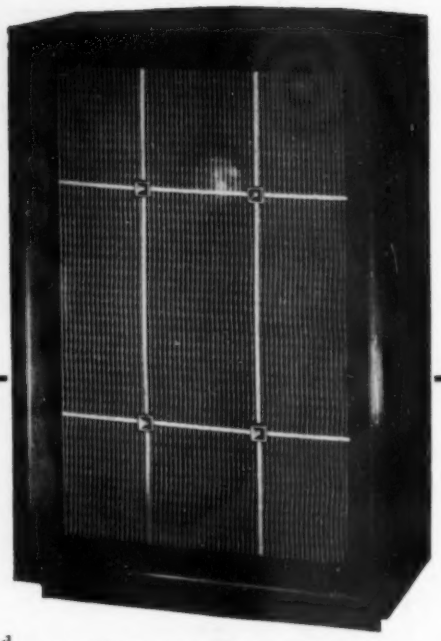
(*Continued on page 94*)

Fig. 6. Rear chassis view of the Model 50-C, a self-contained audio control unit.



ELECTRO-VOICE Aristocrat

By **HOWARD SOUTHER**
Electro-Voice, Inc.



The E-V "Aristocrat" enclosure. The performance data covered in article was obtained using the E-V SP12-B "Radax" unit.

Construction details and performance data on a folded corner horn enclosure. It will accommodate any high quality, low resonant frequency, 12-inch loudspeaker.

THE mind through the ear delights in the stimulus caused by sounds which are mathematically related. The generation of such sounds is called music. It is generally conceded that the widest variety of these sounds causes the greatest satisfaction; thus, we find that loudspeaker systems of the widest response range are the most pleasing, granting good source material of low distortion as an understood prerequisite.

Where space is limited there is no particular problem in achieving excellent response in the treble ranges. Generating mechanisms for producing the rapid, delicate pulses of the higher frequencies are inherently small in themselves. But not so the bass range, comprised of the first two octaves from 30 to 120 cycles-per-second.

The area near a sound generator, in this case the cone of a loudspeaker, is what engineers term a region of high acoustical impedance. To achieve useful transfer efficiency of motion into acoustical energy, we must build up considerable air pressures.

To deliver these sound pressure waves to the listening area, a region of very *low* pressure or low acoustical impedance, a transformer of some kind is required, just as it is in an electrical circuit.

The recognized scientific means of accomplishing this transformer action is through the use of a horn. This horn must expand in area at a constantly accelerating rate to accomplish its function, the ideal horn being one of infinite length and infinite mouth size.

The Horn Design

This last requirement almost stops the design project before it begins. But let us examine first the requirements of a suitable horn. Fundamental tones of even the largest bass instruments, such as monstrous drums and 16 foot organ pipes, start at 30 cycles per second. The mouth requirement for a horn capable of reproducing a 30 cycle tone is ¼ the wavelength of this tone, or 111 inches. For a 50 cps tone, this dimension decreases rapidly to 80 inches.

The next thing to consider is the length of the horn. The formula governing horn design says that the taper rate, or the flare, governing the expanding cross section of the horn, shall double every 1½ feet of its length in order to reproduce a 30 cps tone at the mouth (whose cross section we have already computed to be 111 inches).

The Design Takes Form

Our design still has impossible dimensions for the living room; something having a length of 6 to 10 feet, according to the throat size we select at the start of the horn, and a mouth 10 feet across! On the other hand, certain things are in our favor:

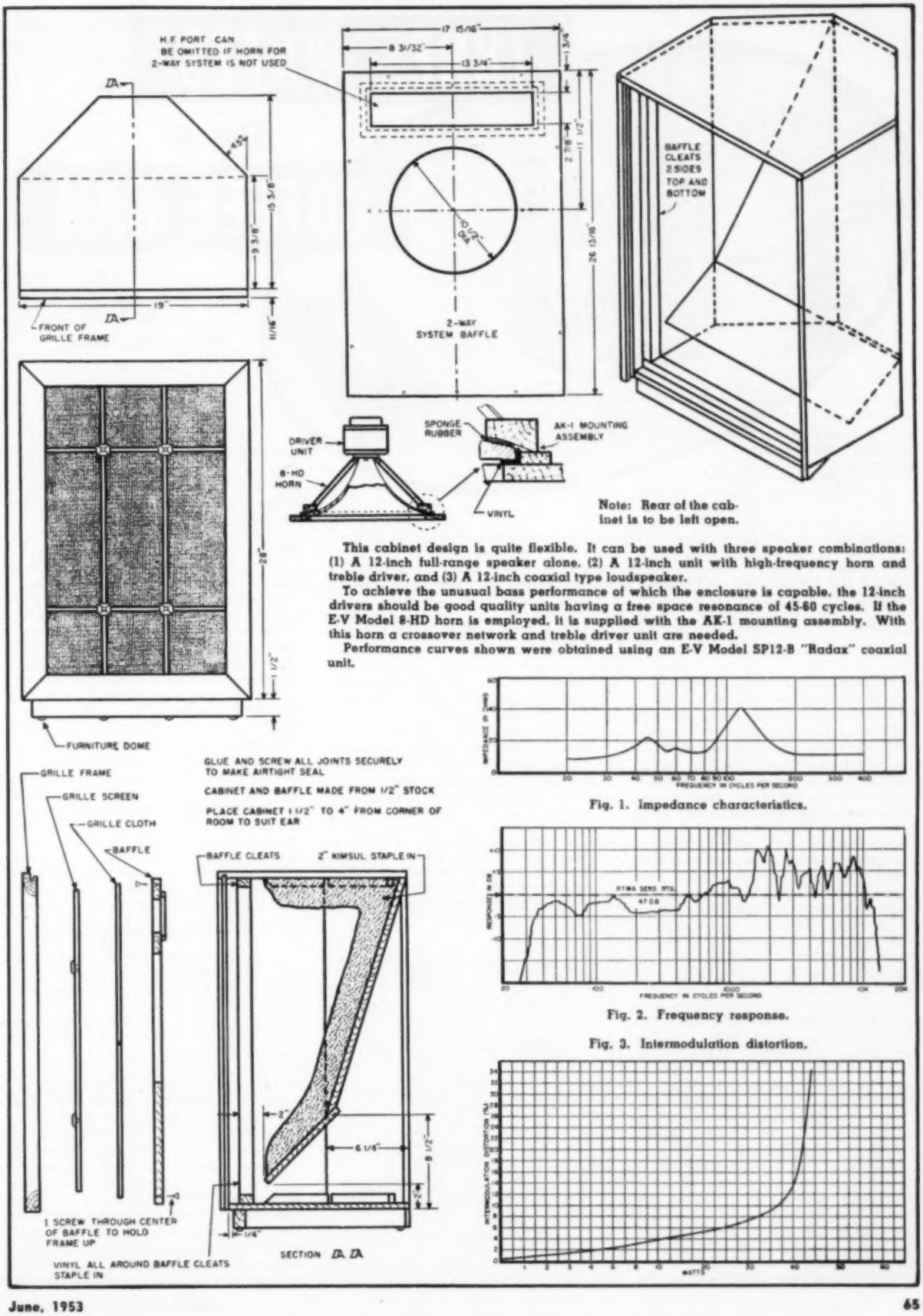
Ideally, the lowest tones in frequency lend themselves easily to propagation in a closed cavity of a size such as our living room. Examination reveals a partial horn available in the *corner* of the room, the mouth of which is in most cases *more* than 111 inches across! Some years ago, Paul Klipsch, the noted acoustics authority, seized upon the idea of housing only the *throat* of the required horn in a furniture cabinet and placing it in this corner. In the design of the "Aristocrat," we find that by keeping the driver unit itself small, we have such a throat assembly of very compact proportions. There now results a clean, extended low-frequency response to the 30 cps region, surprisingly free from peaks and valleys in its characteristic curve. But, although the range is well extended and satisfactory, the efficiency in the first octaves is still too low to accomplish a pleasing musical balance. This is true, in the main, because our driving cone is only a piece of parchment, and a far cry from the ideal acoustical requirement for a piston of infinite lightness and infinite rigidity.

Building the Efficiency

By exploiting a phenomenon involving acoustic resonance, the efficiency in the bass range may be augmented as much as 4 to 8 times. Observe the cross-sectional drawing of the "Aristocrat": By utilizing the reactance of the small air mass directly behind the speaker, in conjunction with the high compliance or capacitive factor of the specialized driver cone, the combination can be used to reinforce the sound over a four-octave band with the large air mass, due to the horn, which is presented by the corner.

Performance

If the "Aristocrat" is carefully constructed, and care is taken to effect a complete seal of the front baffle board to prevent air leaks from front to back, rather startling bass performance will be realized. Response range will be as shown in the curve (Fig. 2) revealing a response within 5 db of flat to about 30 cps. This operation is supported by evidence disclosed in the impedance characteristic (Fig. 1) denoting a satisfactory reactive component in the voice-coil system well into the first octave. The high impedance at 120 cps is fortunately not reflected adversely in the frequency response curve. —30—



Note: Rear of the cabinet is to be left open.

This cabinet design is quite flexible. It can be used with three speaker combinations: (1) A 12-inch full-range speaker alone. (2) A 12-inch unit with high-frequency horn and treble driver, and (3) A 12-inch coaxial type loudspeaker.

To achieve the unusual bass performance of which the enclosure is capable, the 12-inch drivers should be good quality units having a free space resonance of 45-60 cycles. If the E-V Model 8-HD horn is employed, it is supplied with the AK-1 mounting assembly. With this horn a crossover network and treble driver unit are needed.

Performance curves shown were obtained using an E-V Model SP12-B "Radax" coaxial unit.

Fig. 1. Impedance characteristics.

Fig. 2. Frequency response.

Fig. 3. Intermodulation distortion.

THREE WATTS IN A COFFEE CAN

By
JIM FAHNESTOCK,
W2RQA

The components for the 3-watt transmitter are mounted on a coffee-can lid. The r.f. tank assembly shown is from a BC-746 tuning unit; equivalent parts may be used.

Built for less than five dollars, this three-watter brings back the simplicity, economy, and ingenuity of "the good old days." A challenge to operating skill, and some real fun.

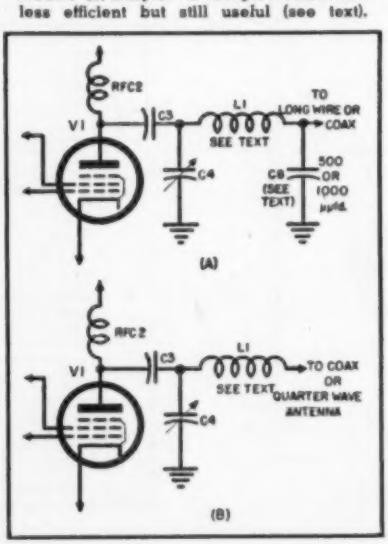
IN AUTOMOBILE racing, midget racers draw the most consistent crowds. In sailboating, the greatest spirit is displayed in the small boat classes. The true sport comes from competition where equipment used is standard to all contestants, and the simpler the equipment, the more the fun.

The coffee-can transmitter described in this article was designed to be a contest midget for hams. The idea was conceived at a meeting of the Wantagh (Long Island) Radio Club after an evening of the usual argument over ways to stimulate operating activity among club members. Club nets and contests were discussed, but it was not until the coffee-can rig was suggested that these ideas took hold.

To make the idea of building a low-power transmitter attractive to the greatest number of members, low cost was placed at the top of the list of design requirements. The final circuit chosen, after a painstaking, penny-conscious investigation of every conceivable combination of available parts, is shown in Fig. 2. With a little shopping around in the surplus ads, all the parts including tube, crystal, power supply, and key can be purchased for less than a five-dollar bill. To a man with a good junk box and the standard "odds and ends" of surplus, this can nearly be a "no-cost" transmitter.

The pentode portion of a 117L7GT is connected as a modified Pierce oscillator running about three watts input in the 80-meter c.w. band. The diode portion of the tube serves as a half-wave rectifier and provides approximately 125 volts d.c. through a simple *RC* filter. The crystal socket and plate tank condenser and coil can be obtained already mounted on a convenient subchassis from a BC-746 tuning unit available at surplus. Only a handful of readily available parts are required to complete the circuit.

Fig. 1. Alternate ways of feeding power to the antenna (see Fig. 2). (A) "Pi" network for random-length wires or a coaxial feeder. (B) Simpler "L" coupler, somewhat less efficient but still useful (see text).



The top of the coffee can serves as a chassis and the can itself provides an air tight (and incidentally a TVI-proof) cabinet. Placement of parts can be seen in the photographs. The BC-746 tuning unit is mounted as close to the edge of the can lid as possible after all the original wiring and the fiber jack strip that comes attached to each unit is removed.

The octal tube socket for the 117L7GT is mounted on a pair of right-angle brackets and furnishes convenient tie points for the small parts of the power supply and r.f. section. A two-terminal strip mounted on the can top directly beneath the tube socket furnishes feedthrough connection for the keying leads (a jack may be substituted, if desired) and an *RCA* phonograph plug serves as a feed-through for the antenna. The line cord passes through a ⅜-inch hole in the can top fitted with a rubber grommet.

Power Supply Precautions

In order to keep cost at a minimum, a transformerless a.c.-d.c. type power supply is used. This introduces a shock hazard unless proper care is taken to plug the line cord into the wall socket in such a way that the wire connected directly to the coffee-can ground is the wire that connects to the grounded side of the a.c. line.

One procedure for orienting the plug in the correct manner is as follows: Connect a small 117-volt light bulb between the coffee-can chassis and a good external ground, such as a water pipe. The plug is then inserted in the wall outlet. If the bulb lights, the plug has been inserted incorrectly and should be reversed. Once the correct orientation has been determined, plug and socket can be marked in some convenient way to insure correct insertion

each time the rig is plugged in. A dab of paint on one side of the plug and alongside the corresponding socket hole will serve as a permanent guide.

Tuning Procedures

In tuning the rig initially, a 0 to 100 ma. meter may be connected across the key terminals to indicate a dip in cathode current when C_4 is adjusted to resonance with L_2. An alternate tuning procedure is to tune C_4 until maximum "S"-meter reading is indicated on a nearby receiver. A single-turn link with a 0.25-ampere pilot lamp placed around L_2 will also provide an indication of resonance.

Some of the Wantagh gang who made these rigs found that sluggish crystals would refuse to oscillate or follow keying in this circuit. This was easily remedied by the insertion of a 250 $\mu\mu$fd. condenser, C_7, shown in dotted lines on the diagram, from the screen grid of the 117L7GT to ground. New and active crystals ought to take right off, and C_7 can be eliminated, saving fifteen cents or so in the overall cost.

If the BC-746 tuning unit is used, either the 3825 or 5500 kc. coil may be used without modification if the link output arrangement shown in Fig. 2 is used. This arrangement will match coax or a 300-ohm twin-lead line.

Two alternate systems for coupling energy to the antenna are shown in Fig. 1. By experimenting with values for C_4, L_1 and C_5 in the *pi* network shown in Fig. 1A practically any length of wire can be made to take power from the rig. To match low-impedance antenna systems with the *pi* network (coax or quarter-wave antennas) the tuning unit coils should be pruned to about 30 turns for best results. For coax output C_5 should be somewhere between 500 $\mu\mu$fd. and 1000 $\mu\mu$fd. After the value of C_5 has been determined for best results for one crystal in the 80-meter band, no further changes in that value are required for other frequencies in that band. C_4 is adjusted for resonance at each new frequency in the band.

The *L* network shown in Fig. 1B is admittedly not ideal from the standpoint of harmonic attenuation, but with the low power level involved, no trouble has been noticed and good transfer of power is obtainable.

If TVI is noticed emanating from the coffee can, it is a fairly safe bet that r.f. is being fed back through the line *via* the direct connection in the power supply. This can be eliminated completely by inserting a small u.h.f. choke in series with the "hot" side of the line inside the coffee can and bypassing the rectifier plate connection with a small .005-μfd. mica or disc ceramic condenser.

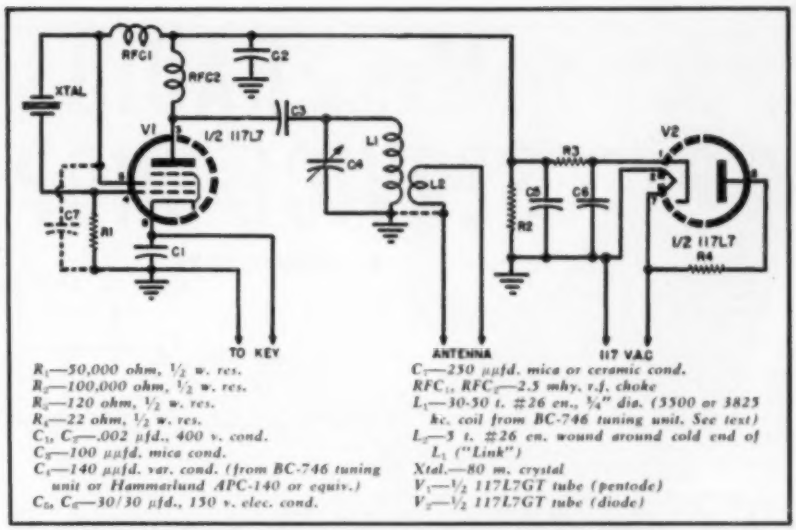
Operation

Experience in operating the coffee-can rigs shows very clearly that they get reports that compare quite favorably with rigs running considerably more power. It is interesting to note reactions from operators on the other end when you explain that you are running *three watts*. On regular Wednesday night gab fests around town surprisingly little trouble from QRM has been observed, and it is comforting to know that you are actually complying with the FCC regulation that says, "Ye shall use only enough power to accomplish the desired communication."

If a group of locals can be talked into building coffee-can rigs, a great amount of pleasure can be derived from rag chews, practice CD nets, and local contests. If a common frequency is adopted, it is usually a simple matter to get into a relaxing chat without firing up the big "TV eliminator," and considerable satisfaction results from the realization that you are doing very little to contribute to the retirement fund of the local power company officials.

Since the birth of the coffee-can rigs in Wantagh, the number of idle kilowatts has risen considerably, but the number of operating hours has also gone up. Contests to see who can work the most states or the most distant station in a given period of time are sometimes quite revealing, since they show who is the best operator, and not who has the fattest pocketbook.

A variety of modifications of the basic design is possible for different requirements. By appropriate wiring changes and tube substitutions, battery operation is feasible for CD work and local field days. The main thing is to get the gang started, and this is best accomplished by keeping cost and complexity to a minimum. —30—



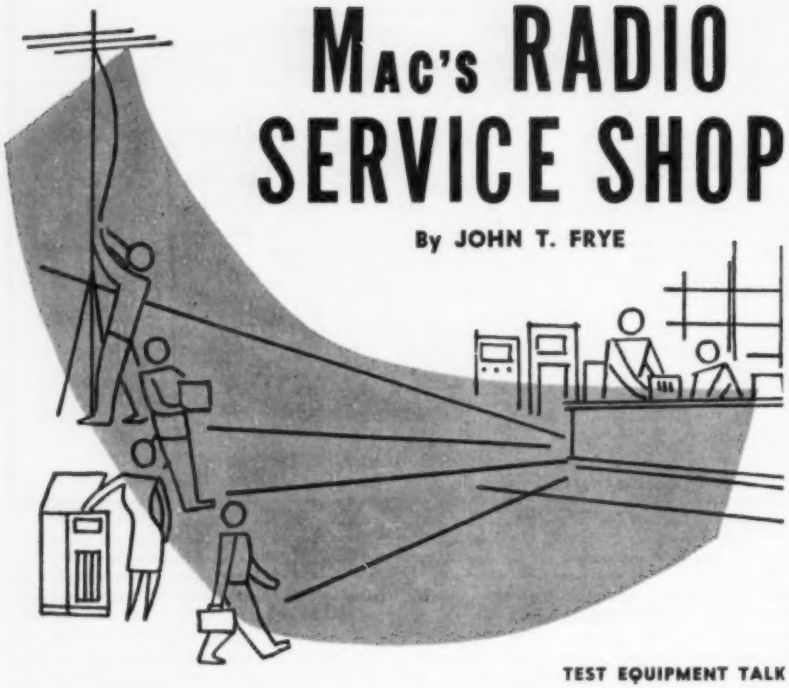
R_1—50,000 ohm, ½ w. res.
R_2—100,000 ohm, ½ w. res.
R_3—120 ohm, ½ w. res.
R_4—22 ohm, ½ w. res.
C_1, C_2—.002 μfd., 400 v. cond.
C_3—100 $\mu\mu$fd. mica cond.
C_4—140 $\mu\mu$fd. var. cond. (from BC-746 tuning unit or Hammarlund APC-140 or equiv.)
C_5, C_6—30/30 μfd., 150 v. elec. cond.
C_7—250 $\mu\mu$fd. mica or ceramic cond.
RFC_1, RFC_2—2.5 mhy. r.f. choke
L_1—30-50 t. #26 en., ¾" dia. (5500 or 3825 kc. coil from BC-746 tuning unit. See text)
L_2—3 t. #26 en. wound around cold end of L_1 ("Link")
Xtal.—80 m. crystal
V_1—½ 117L7GT tube (pentode)
V_2—½ 117L7GT tube (diode)

Fig. 2. Complete schematic of the 3-watt "coffee can" transmitter. It is complete with its power supply inside a one-pound coffee can. "Phono" jacks may be used for the key and antenna. C_7 (dotted lines) is added for sluggish crystals (see text).

Enclosing the transmitter in its coffee can affords good shielding for TVI and, like any cabinet, protects the circuit. Unless the line plug is polarized correctly, the can will be "hot" with a.c. (see text). The antenna jack is at upper left.

MAC'S RADIO SERVICE SHOP

By JOHN T. FRYE



TEST EQUIPMENT TALK

THE doors of Mac's Radio Service Shop were opened wide to the soft June breeze, and Mac and his red-headed helper, Barney, were displaying strong symptoms of belated spring fever as they sat on the service bench drinking their mid-afternoon Cokes. Neither seemed in a hurry to get back to work. Mac was lazily leafing through the current issue of a radio magazine, and Barney was dreamily practicing his imitation of the river steamer *Robert E. Lee* saluting a friend of the pilot standing on the Friar Point levee. Of course, if you were a dull clod you might have thought he was just blowing across the mouth of an empty Coke bottle, but to admit this would have been to brand yourself as a person of no imagination.

"You know, Flame-head," Mac drawled, "a lot of us have been so busy trying to keep up with the progress of the radio and TV sets we work on that we have failed to notice the improvements made in the instruments we work *with*."

Barney gave a final mournful toot on the deep-throated whistle of the *Robert E. Lee* and asked, "What brought that on?"

"I was just looking at this ad for a 20,000-ohms-per-volt volt-ohmmeter, which happens to be the same one we use here, and thinking what a far cry it is from that old 1000-ohms-per-volt tester I used for so many years. A funny thing is that many technicians have gone directly from that old-fashioned v.o.m. to the exclusive use of a v.t.v.m., and they still think that all v.o.m.'s are as insensitive and load circuits being tested as heavily as did that old-fashioned job."

"Well, volt-ohmmeters still have a lot less resistance than vacuum tube voltmeters," Barney argued.

"That depends upon what scale of the v.o.m. you use. I'll grant you that when both instruments are used on the low-range scales, the vacuum tube job is much superior, for the typical v.t.v.m. has a fixed resistance of ten megohms in the instrument and one megohm in the probe for a total of eleven megohms on all scales. The 20,000-ohms-per-volt meter, on the other hand, has a variable resistance that is always equal to twenty thousand times the full-scale voltage of the range being used. That means that on the five volt range its hundred thousand ohms compares very poorly with the v.t.v.m.'s eleven megohms; but on the 500 volt range the v.o.m.'s ten megohm resistance is nearly equal to that of the v.t.v.m., and at 1000 volts the v.o.m. has surged far ahead with a resistance of twenty megohms. When high voltage probes are used with both instruments to increase their range to say 30,000 volts, the resistance of the v.t.v.m. is raised to only about 300 megohms, while the resistance of the 20,000-ohms-per-volt meter is 600 megohms. That means if it is used to check the high voltage of a picture tube, it will draw only half as much current as will the v.t.v.m."

"Say, how about that!" Barney exclaimed with sudden interest. "I never realized that was true. Any old time you get above about 500 volts, the loading of a modern v.o.m. is actually less than that of a v.t.v.m."

"True, and I might add that the bearings used in the 50 microampere meter movements employed in these 20,000-ohms-per-volters are so good that the readings obtained on the lower parts of the scales are quite accurate and dependable. That means you can use a high range scale to insure minimum loading and still be able to depend upon the readings obtained."

"Looks as though there's not much sense in buying a v.t.v.m. at all," Barney observed.

"Now let's not get carried away," Mac warned. "I still think that the v.t.v.m. is the ideal service instrument for bench use. When measuring such things as oscillator bias, a.v.c. and a.g.c voltages, etc., it can't be beat; and as long as you are around, I am greatly comforted by the thought that it is practically impossible to damage the meter by accidentally using the wrong scale. On the other hand I think that every shop should have a good 20,000-ohm-per-volt v.o.m. These meters are quite rugged and will stand up under portable use better than the v.t.v.m.'s. They are always ready for instant use in any location, requiring neither a warm-up period nor external power source. You do not have to worry about changes in line voltage or aging tubes affecting their accuracy; consequently, you always feel a little more confident about the accuracy of readings you obtain with a v.o.m. Both types of meter have their good and bad points that supplement each other. The technician needs both of them."

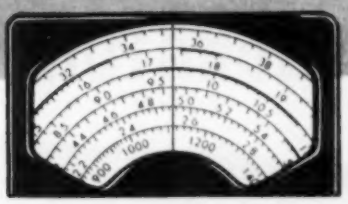
"That's just one instrument that has been improved," Barney pointed out. "Are there others?"

"Sure thing. Take the oscilloscope for example. Just before the Second World War was when the scope really moved out of the laboratory into the service shop. That was when a lot of technicians bought their first scopes, and the instruments they bought were very limited in both sensitivity and frequency range. That job we use for checking vibrators is typical of those early oscilloscopes, and you will recall that when we checked it out with the voltage calibrator and square-wave generator a while back we found that the deflection sensitivity was .65 volt per inch and that the response of the amplifiers fell off very rapidly above 50,000 cycles; furthermore, the setting of the amplifier gain control had a tremendous effect on the response of the amplifier itself.

"A few of the fellows," Mac went on, "who think 'an oscilloscope is an oscilloscope,' are still trying to use these ancient jobs for TV service. Others who have bought modern instruments for TV alignment purposes still think of the *general* uses of the oscilloscope in terms of the very limited possibilities they discovered when they experimented with those early models. They do not realize that the modern scope with its ten or twenty millivolts-per-inch sensitivity, its frequency range extending up into the megacycles, and its step-type nonfrequency-affecting attenuator will do dozens of jobs in radio and TV service

(*Continued on page* 110)

International SHORT-WAVE



Compiled by KENNETH R. BOORD

THIS month's cover features your short-wave editor, Ken Boord, at the *ISW DEPARTMENT* Listening Post at his home, 948 Stewartstown Road, Morgantown, West Virginia, USA.

The equipment in the photograph includes a *Hammarlund* SP-600-JX (Super Pro); a *Hallicrafters* SX-73; a *National* NC-183-D; a *Hallicrafters* SX-28; an *RME* DB22A preselector; a Panadaptor; and a BC-221-AH frequency meter. The tiny receiver atop the Panadaptor is your short-wave editor's first radio—a crystal set dating to the mid-1920's.

The Listening Post employs straight-wire antennas and doublets cut to the popular short-wave bands. Best overall results have been obtained with a 300-ft. straightwire. Lead-ins are of 100-ohm shielded twin-lead transmission line.

Your short-wave editor began SWLing in the early 30's, first using a converter, and then a four-tube short-wave receiver with plug-in coils and a speaker made from an old automobile horn and a headphone set. He was a contributor to RADIO & TELEVISION NEWS' short-wave department in the 30's and to leading radio organizations. He began the *ISW DEPARTMENT* with the June 1944 issue.

* * *

Around the World

(*NOTE:* Some stations may have changed to *summer* schedules since this was compiled; in such cases, you may hear them *one hour earlier* than listed herein.—K. R. B.)

Algeria—Algiers now uses only 6.160 at 0700-1745. (Scheiner, N. J.)

Anglo-Egyptian Sudan—Radio Omdurman noted now near 7.655 signing on 1115 in *English* on Wed.; reported also using 6.437 now. *English* is scheduled Sun., Wed. 1115-1130, Fri. 1230-1300. (Pearce, England)

Argentina—LRA, 9.69, Buenos Aires, has strong signal 2000A. (Dadson, Mich.) Noted to North America East Coast now on 15.345 (*moved* from 17.720) at 1700-1930. (Balbi, Calif., others)

Australia—VLC11, 11.840, is now used to Eastern North America 0700-0845; DX session Sundays 0830.

Belgium—Brussels noted to North America daily over 9.767, in French 1900, *English* from 2030; on Wed. has DX session 2100. (Morrison, R. I., others) Noted closing 2200. (Matherly, Ohio) ORU5, 6.000, strong 1305. (Catch, England)

Belgian Congo—OTH, 9.215, Leopoldville, good level 1200, native. (Catch, England) *Radio College*, OQ2AC, Elisabethville, lists schedule daily 1130-1230 (Sun. 0200-0400) on 7.2, 4.98, 3.39 with 250 watts each; mostly French but on Fri. uses Flemish (or Dutch) and closing announcements include *English*. Hopes to increase power of at least the 4.98 outlet to 500 watts soon. (Scheiner, N. J.)

Bolivia—CP38, 9.497, La Paz, noted on *measured* channel 0645 with religious service in Spanish. (Ferguson, N. C.)

Brazil—PRL7, 9.72, Rio de Janeiro, good level signing on 1930. (Morrison, R. I.) *Radio Jornal do Commercio*, 15.145, noted closing 1433A in *English*, Portuguese; said continuing over 9.565. (Pearce, England) PRK5, 6.000A, Belo Horizonte, noted 1930 with QRM, weak. (Washington, N. J.) ZYC8, 9.610, Rio de Janeiro, fair level 2020; PRC5, 4.865, Belem, good level 2000 with news in Portuguese; ZYY9, 4.97575, Sao Luiz, heard at fair strength 2045. (Catch, England) ZYK2, 9.565, Recife, noted from 1530 at good level in Sweden. (Friberg)

British Honduras—Occasionally, Belize, 4.950A, is in the clear around 1900. (Black, Pa.)

Bulgaria—Sofia, 9.700A, good in *English* to North America 2000-2030. (Klein, Va.) Noted on 6.070 in *English* 1600-1630. (Hanel, Sweden)

Burma—Rangoon, 4.774A, is heard in Sweden 0900-1000 in *English*. (GDX-aren, Sweden)

Cape Verde Islands—CR4AA, 7.130A, Praia, noted 1557-1700 when closed with "A Portuguesa." (Pearce, England) More recently has *moved* to 7.395A. (Washington, N. J.; Mercier, France, others)

Ceylon—Radio Ceylon, 11.975, noted closing Thur. 1215; Fri. 1230, other days 1145. (Fuller, R. I., others)

China—Wahun, 6.645, heard 0618, had CWQRM. (Ballou, Calif.)

Colombia—HJEF, 4.768, Cali, noted 2308-2332. (URDXC) *Radio Pacifico*, HJEX, 6.054, Cali, good around 2100-2130. (Norman, N. C.) HJAE, Cartagena, noted close to 4.9665 around 2300. (Gaylord, Washington State) HJCQ, 11.680, Bogota, carries *"English by Radio"* 1930. (Niblack, Ind.)

Costa Rica—Radio Athenea, San

(*Continued on page* 130)

(Note: Unless otherwise indicated, all time is expressed in American EST; add 5 hours for GCT. "News" refers to newscasts in the English language. In order to avoid confusion, the 24 hour clock has been used in designating the times of broadcasts. The hours from midnight until noon are shown as 0000 to 1200 while from 1 p.m. to midnight are shown as 1300 to 2400.)

The symbol "V" following a listed frequency indicates "varying." The station may operate either above or below the frequency given. "A" means frequency is approximate.

Eduardo Lopez Juarez, CE3CB, of San Miguel, Chile is shown in his radio "shack." Equipment includes a 50-watt transmitter, a three-tube receiver, and a "Little Giant Station." Mr. Lopez Juarez is a Major Sub-Officer in the Chilean Air Force in the Radio Communications Branch. At the present time he is stationed at the Central Airfield of the Air Force. CE3CB is one of the world's best-known calls, having been on the air for over 15 years and participating in thousands of successful QSO's.

AN OSCILLOSCOPE CALIBRATOR

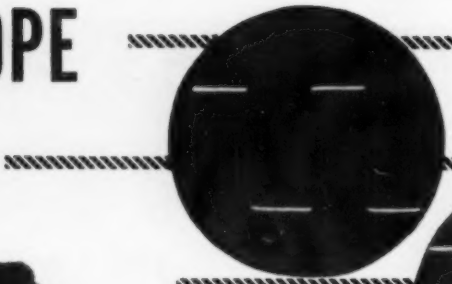


Fig. 1. Output square wave of unit.

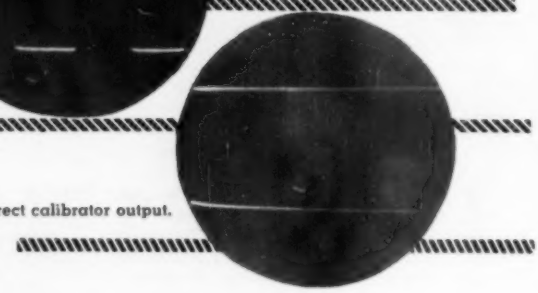
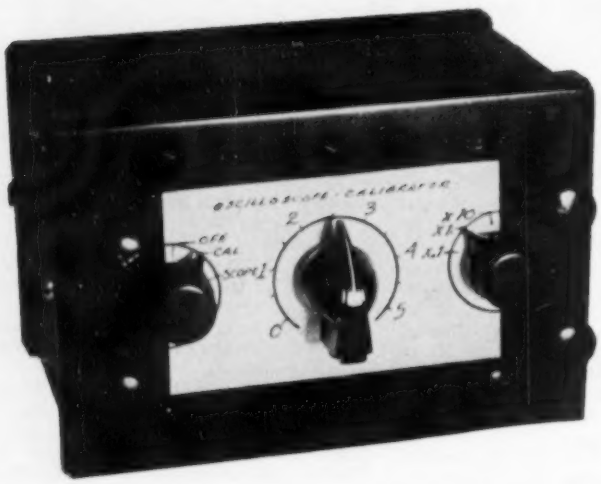


Fig. 2. Correct calibrator output.



Front view of scope calibrator. It is housed in a compact case.

By

RICHARD GRAHAM, W1VJV

An easy-to-build accessory unit that will increase the versatility and usefulness of your shop oscilloscope.

VERY often service technicians, experimenters, and hams use their oscilloscopes just for the observation of waveforms. When they do, they're only getting half the value of their scopes. With the addition of the easily constructed oscilloscope calibrator described herein, the scope can be used for actual voltage and current measurements as well as for waveform observation.

The oscilloscope calibrator is nothing more than an a.c. voltage standard, the output of which is independent of line voltage variations. It would be very convenient if we could use a battery or other such stable d.c. source for scope calibration, just as in the usual d.c. meter calibration, but unfortunately we can't since the oscilloscope, or at least the usual one, responds only to a.c. Thus it becomes necessary to construct some sort of device that will produce a constant a.c. signal regardless of any external varying conditions. For oscilloscope calibrating, a square wave provides the most convenient waveform since the top and bottom of the wave are at definite places, not like, for example, a sine wave with its gradually sloping sides. Another advantage is that a square wave is all "top and bottom with nothing in between." Thus because the transition time between the bottom peak and top peak is so very rapid, there appear to be only two lines on the scope when the sweep frequency is greater than the input square-wave frequency. This provides a very convenient pair of reference lines for calibrating the oscilloscope screen. This effect is shown in Fig. 2.

To make an a.c. voltage standard it is convenient to revert back to a d.c. source which can be more easily and economically controlled. This regulated d.c. source must then be converted back to a.c. This can be accomplished with a simple multivibrator supplied with power from a d.c. regulated power supply. The output of this multivibrator is then fed into an attenuator and calibrated potentiometer to provide a.c. outputs in steps for ease in measuring waves of different amplitudes.

In the unit constructed and shown in the accompanying photographs, this is accomplished simply by using an a.c.-d.c. type of power supply using a 65 ma. selenium rectifier and an 0B2 voltage regulator tube. This then makes the multivibrator output independent of line voltage changes. A word of caution for those living in very low voltage areas might be advisable here. The 0B2 voltage regulator tube requires a minimum d.c. anode supply of 133 volts to insure starting throughout the tube life. Thus if your line voltage drops below 96 volts, there is the possibility that the 0B2 will not fire or may be erratic in operation. In such a case the principles discussed here still apply, however a standard type of transformer supply will have to be substituted. This would, of course, necessitate a change in the voltage regulator dropping resistor, the exact size depending upon the power supply voltage used.

This regulated d.c. is then used for the plate supply of a simple multivibrator using a 12AU7. The actual frequency that is produced by the multivibrator is relatively unimportant, the important considerations being its constancy of amplitude with varying line voltages and with time. However, for the values shown, the multivibrator is free running at approximately 500 cycles.

By taking the output from the multivibrator from plate-to-plate of the 12AU7, an almost perfect square wave is obtained. This output is fed into a calibrating potentiometer, R_4; then to an attenuator consisting of resistors R_5, R_6, and R_7; then into a calibrated potentiometer, R_8. This latter pot is the one which is mounted on the front panel of the calibrator.

The actual peak-to-peak voltage appearing from plate-to-plate on the 12AU7 is approximately 90 volts—not quite 100. Therefore, to provide a convenient voltage scale for the potentiometer R_8, it was decided to make the output read 0 to 5 and in multiples of 10, *i.e.*, X1, X10, X.1.

To obtain the greatest accuracy, the attenuator should have the values shown on the parts list as R_5, R_6, and R_7. In the actual unit constructed, these were selected from standard values of 100,000, 10,000, and 1000 ohms respectively. However, if it is intended to purchase these parts (where selection of resistor values isn't too practical) sufficient accuracy can be obtained by using standard 5% resistors of the values 91,000, 9100, and 1000 ohms respectively for R_5, R_6, and R_7. The calibrated potentiometer which is placed in parallel with these resistors has enough greater resistance

value so as to have a negligible effect on the accuracy.

For the operator's convenience, the switch S_1 is included. It is a three-position, four-pole switch that does a little more than just turn the calibrator on and off. In the "Off" position, S_1 disconnects the a.c. line from the unit and also provides a continuous circuit from the terminals on the left (the input terminals) to the terminals on the right (the output terminals). In use the calibrator output terminals are wired permanently to the vertical input terminals on the scope. Thus, in effect, the input terminals of the calibrator now become the input terminals of the scope.

When switch S_1 is in the position marked "Scope," the input and output terminals are still tied together, except that the a.c. is turned on and the "B +" is turned off. It was found necessary to remove the "B +" in this position to keep from feeding any of the calibrator output into the scope through the wiring and switch capacities.

The calibrate position of switch S_1 opens up the input terminals of the calibrator and feeds the multivibrator output into the output terminals for calibrating purposes.

The initial calibration performed after the unit is completed is simple and involves merely setting the calibrating pot R_6. This potentiometer sets up the standard voltage fed into the attenuator, which in this case is 50 volts peak-to-peak. Other methods of calibrating may suggest themselves to the builder, but the method to be described is easy, accurate, and involves only the use of an a.c. meter in addition to the calibrator and scope. This procedure is as follows. The line voltage is measured as accurately as possible with the a.c. meter. This value is then multiplied by 2.83. This gives the peak-to-peak value of the line voltage. The line voltage is then applied to the input terminals of the calibrator, the output terminals being connected to the input of the scope. Switch S_1 on the calibrator is set to the "Scope" position. The vertical gain control on the scope is then adjusted for any convenient height on the scope screen. Now by proportion:

$$\frac{E_1}{H_1} = \frac{50}{H_2}$$

where E_1 is the peak-to-peak line voltage, H_1 the height of scope trace with E_1 applied, and H_2 is the height of calibrator output on the scope.

Since we are interested in finding what should be the height of the calibrator output, we can restate the above and say:

$$H_2 = \frac{50H_1}{E_1}$$

Now with the calibrator dials set at X10, the potentiometer on the panel (R_6) set fully clockwise, and switch S_1 on "Cal," the calibrating pot located on the chassis (R_6) is turned to produce the height found by the equation. The calibrator is now putting out a standard 50 volt peak-to-peak signal.

The next step is to calibrate potentiometer R_5. With the switches set in the same positions as before, adjust the scope vertical gain to produce any height or number of squares conveniently divisible by 5 or 10. This height represents 50 volts. Adjusting potentiometer R_5 to 4/5, then 3/5, then 2/5, etc. of the 50-volt height would give calibration points at 40, 30, and 20, etc. volts respectively. As potentiometer R_5 is set at these points, calibrating marks are made in pencil on a paper scale. When the calibration is complete, the dial can be inked in. To give the paper scale a more durable surface, a coating of colorless nail polish can be applied.

Now the calibrator is all set for use. There are two common methods of using a device such as this. The first method is simply to calibrate the screen of the scope for a certain number of volts-per-square, or volts-per-

(*Continued on page* 106)

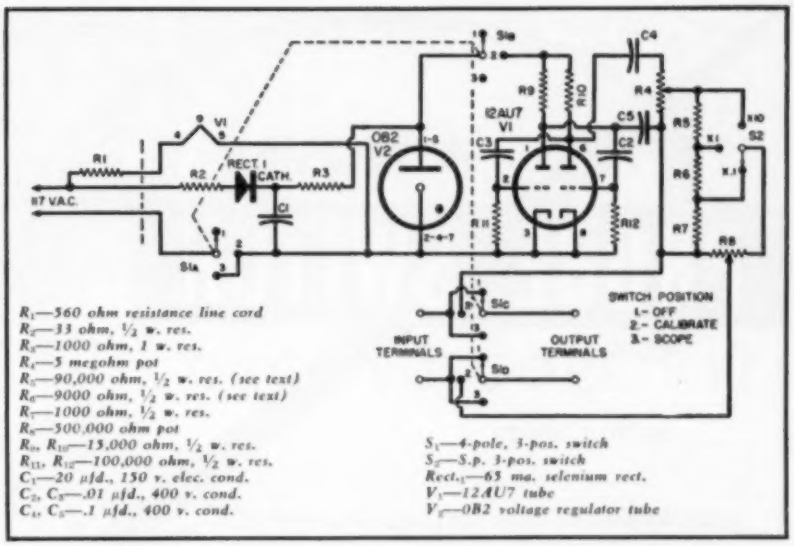
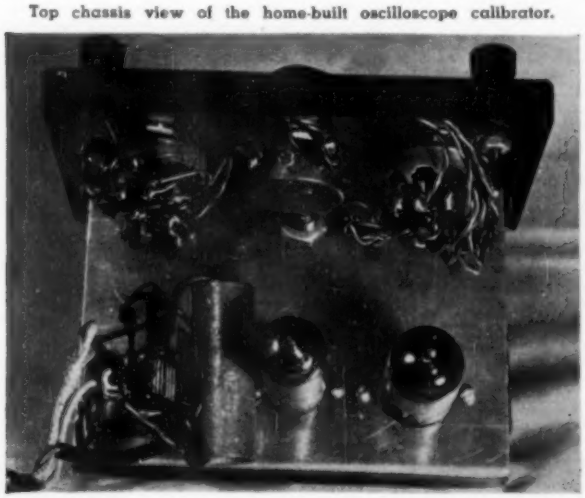
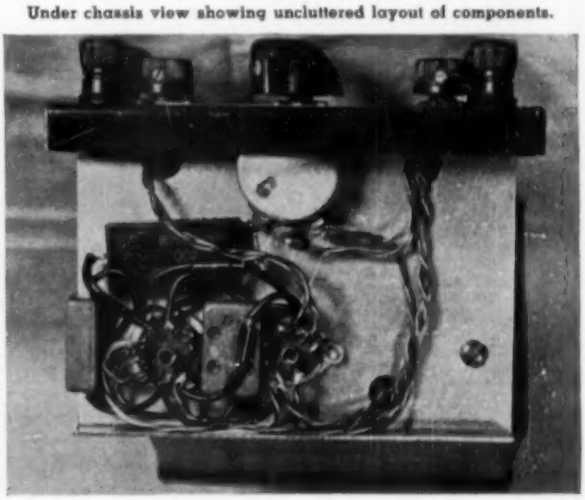


Fig. 3. Complete schematic diagram of the oscilloscope calibration accessory.

Top chassis view of the home-built oscilloscope calibrator.



Under chassis view showing uncluttered layout of components.



A NOVEL PROBE SWITCH

By

MILTON WHITE

Fig. 1. Over-all view of the probe in which the s.p.d.t. switch is installed.

Mechanical details for assembling a rotary switch within a probe. Converts the d.c. probe to a.c.-d.c. operation.

SINCE their inception as general service instruments, vacuum-tube volt-ohmmeters have required the use of separate probes for d.c. voltage, resistance, and a.c. voltage measurements. This is a disadvantage, made necessary by the capacity isolation resistor required at the probe tip when measuring d.c. volts.

Attempts have been made in some commercial instruments to overcome this disadvantage by the use of a separate resistor, mounted so that it may be attached to the probe tip, or by the installation of a switch within the probe handle.

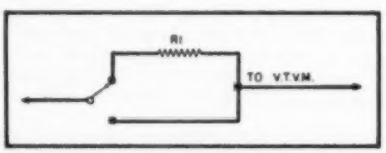


Fig. 3. Wiring diagram of probe switch.

The operating convenience that results from these measures is not as great as it should be. There is little difference between continually attaching or removing the resistor, or using another probe. When a switch is employed, the size of the probe necessary for its installation makes this part too large for practical use in close quarters.

The probe switch to be described is the answer to this problem, when it is used with instruments that have the same type of panel connectors for the attachment of their probes. For example, the *Simpson* Model 303 is an instrument of this type. The *RCA* Model WV-77A is especially well suited to this probe, because it has only one attachment point for all functions.

The switch is simple, rugged, and so small that it may be encased within a pencil-type probe only ⅝ in. o.d. Operated by a simple twist of the probe tip, without reference to any indicating mark, its use quickly becomes practically automatic to the user.

The unique construction of the switch may require some explanation, so let's examine Figs. 2A through 2E, and see the major points of its assembly and operation.

First, select a one-half watt carbon resistor of the same value as the one used in the d.c. voltage probe of your instrument. This may be done by using the instrument probe as a resistance standard. It should be matched to ± 1%, or adjustment of the d.c. volts calibrating resistors within the v.t.v.m. may be necessary. This resistor is R_1 in Fig. 2B.

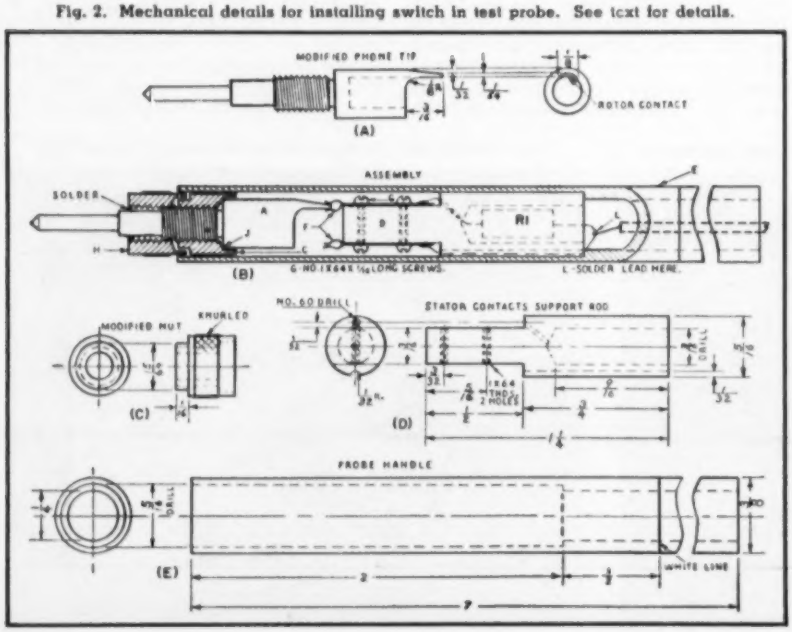
Next, note the stator contacts *F*, Fig. 2B. Then, look in your junk box for an old rotary selector switch from which two such contacts may be taken. They, together with resistor R_1, and 5 feet of microphone cable, not shown, are attached to the stator support bar, Fig. 2D, to complete the sub-assembly. This unit is secured within the handle, Fig. 2E, by a little shellac. Three to four drops allowed to run down the inner wall of the tube, after the sub-assembly has been slipped into place, will be drawn by capillary attraction into the crevice between the assembly and the handle, where it belongs. When the shellac hardens, it will firmly bind these parts together.

The heart of this switch is the rotary contact, made from a solderless phone tip, filed as shown in Fig. 2A. A shoulder is formed on the phone tip nut, as indicated in Fig. 2C, and it is then run all the way on the phone tip. Next, an additional phone tip nut, not modified, (*H*, Fig. 2B) is screwed on tightly against the first one, then backed off exactly one-half turn and soldered to the phone tip in this position.

Spread a film of "Miricale Adhesive" (*Miricale Adhesive Co.*, Newark, N. J.) around the knurled section only of the shoulder nut, Fig. 2C, and around the inside of the wall of the

(*Continued on page 92*)

Fig. 2. Mechanical details for installing switch in test probe. See text for details.



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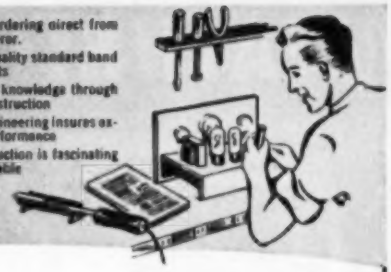
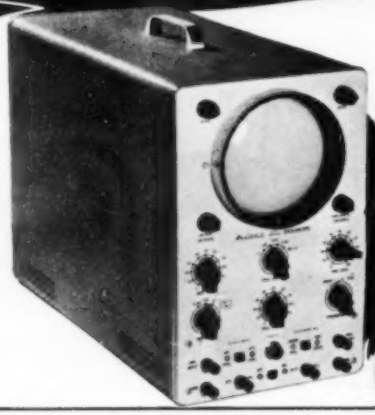


Heathkit MODEL O-8 OSCILLOSCOPE KIT

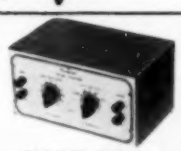


$43.50* Shipping Wt. 26 lbs.

The outstanding new 1953 model O-8 Heathkit Oscilloscope features the finest performance ever offered in this extremely popular kit instrument. Primarily intended as a general purpose oscilloscope for the faithful reproduction of actual wave forms and other electrical phenomena, it's vastly improved band width, good 100 KC square wave reproduction, three step vertical input attentuator, .025 volts per inch vertical sensitivity, etc., admirably qualify this instrument for TV and radio servicing, laboratory use, ham application and all general electronic development work. Improved vertical band width is obtained through the use of shunt peaking chokes with proper cathode compensation in the push-pull output stage. For additional flexibility of operation, provisions have been made for direct connections to the deflection plates, a Z axis input and a spot shape control for really fine focusing.

This beautiful kit is complete with all 10 tubes, including a 5" cathode ray tube, calibrated graph screen and flexible test leads. All necessary construction components, such as hardware, chassis, transformer, etc., and a detailed step by step construction manual, greatly simplify the assembly of this instrument.

Heathkit VOLTAGE CALIBRATOR KIT



The use of a Voltage Calibrator will greatly increase oscilloscope usefulness. Provides a convenient method of making peak to peak voltage measurements by establishing a relationship between the unknown wave shape and the Voltage Calibrator. Voltage ranges .01–100 volts peak to peak. The Voltage Calibrator features direct reading scales and a regulated power supply system.

MODEL VC-2
$11.50*
Shipping Wt. 4 lbs.

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The Heathkit Electronic Switch Kit will further extend scope usefulness by permitting simultaneous observation of two individually controlled traces. Continuously variable switching rates 10 cps to 2,000 cps in three ranges. Will also serve as a square wave generator over the range of switching frequencies.

MODEL S-2
$19.50*
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Heathkit VACUUM TUBE VOLTMETER KIT

MODEL V-6
$24.50*
Shipping Wt. 6 lbs.

The beautiful new 1953 Heathkit Model V-6 VTVM, the world's most popular kit instrument, now offers many outstanding new features in addition to retaining all of the refinements developed and proven through the production of over 70,000 VTVM kits. The Heathkit VTVM now features extended voltage ranges with 50% greater coverage on the DC range. New 1½ volt low scale provides well over 2½ inches of scale length per volt permitting faster measurements with greater accuracy. AC and DC ranges are 0–1.5–5–15–50–150–500–1500 volts (1,000 volts maximum on AC). Ohmmeter ranges are X1, X10, X100, X1,000, X10K, X100K X1 meg. Measures .1 ohm to 1,000 megohms. Other features are db scale, center scale zero adjust and polarity reversal switch. High 11 megohm input resistance virtually eliminates circuit loading.

The low anti-inflation price of this tremendously popular kit includes all tubes, necessary constructional material, test leads and the construction manual.

Heathkit AC VACUUM TUBE VOLTMETER KIT

MODEL AV-2
$29.50*
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The ever popular Handitester is now supplied with a Simpson 400 microampere meter movement. Provides AC and DC voltage ranges 0–10–30–300–1,000–5,000 volts. Ohmmeter ranges 0–3,000 and 0–300,000 ohms. DC current measurements 0–10 and 0–100 milliamperes. A completely self contained portable instrument.

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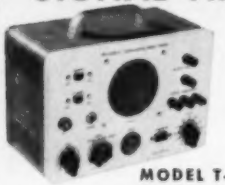

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Convenient band switching eliminates the bother and annoyance of plug in coils. It is merely necessary to switch to the desired frequency and plug in your favorite crystal or VFO. This transmitter features a self-contained power supply mounted on the same chassis and cabinet enclosed to minimize TVI. AC line by-passed to reduce radiation.

The coils supplied with the Heathkit AT-1 are pre-wound and adjusted for the necessary frequency coverage of 80-40-20-10 meters. The entire kit is supplied complete with all tubes, coils, punched and formed chassis and cabinet, as well as all constructional material required. A detailed assembly and operation manual is also furnished.

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Ship. Wt. 8 Lbs.

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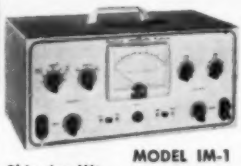

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Shipping Wt. 17 lbs.
MODEL IM-1
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Heathkit
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The Heathkit BG-1 Bar Generator represents another welcome addition to the fast growing line of popular Heathkits. The station transmitted test pattern is rapidly disappearing and the Bar Generator is the logical answer to the TV serviceman's problem in obtaining quick accurate adjustment information.

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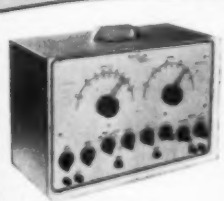
The Heathkit Bar generator is simple to use and is extremely portable, providing a quick means of checking the television receiver either in your workshop or in the customer's home.



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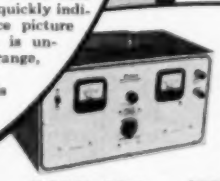

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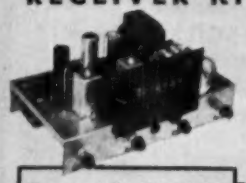

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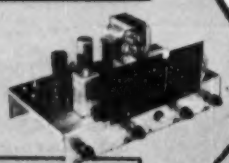

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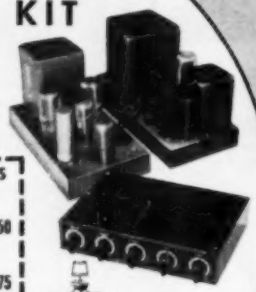

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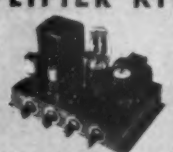
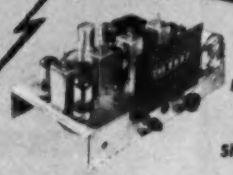
$33.50*
Shipping Wt. 16 lbs.



A high fidelity full 20 watt general purpose amplifier. Dual inputs and separate tone controls for maximum flexibility. Peerless output transformer 4, 8 and 16 ohms.

A-8A with additional preamplifier stage for low level cartridge, microphone, etc. $35.50



Heathkit FM
TUNER KIT

MODEL FM-2
$22.50*
Shipping Wt. 9 lbs.

Sensitive transformer operated 8 tube circuit. Frequency coverage 88-108 mc. Pre-assembled and tuned "front end." Vernier tuning with slide rule type dial.

HEATH COMPANY · Benton Harbor 15, Mich.

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	Heathkit Oscilloscope Kit—Model O-8 (26 lbs.)	$43.50			Heathkit Square Wave Generator—Model SQ-1 (12 lbs.)	29.50	
	Heathkit Amateur Transmitter Kit—Model AT-1 (15 lbs.)	29.50			Heathkit AC VTVM Kit-Model AV-2 (5 lbs.)	29.50	
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	Heathkit Electronic Switch Kit—Model S-2 (11 lbs.)	19.50			Heathkit Handitester Kit—Model M-1 (3 lbs.)	13.50	
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	Heathkit RF Signal Generator Kit—Model SG-7 (8 lbs.)	19.50			Heathkit Three Band Receiver Kit—Model AR-1 (11 lbs.)	23.50	
	Heathkit Tube Checker Kit—Model TC-1 (12 lbs.)	29.50			Heathkit Amplifier Kit—Model A-7 (10 lbs.)	14.50	
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	Heathkit Portable Tube Checker Cab. only No. 365 (8 lbs.)	7.50			Heathkit Amplifier Kit—Model A-8 (16 lbs.)	33.50	
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Please ship C.O.D. ( ) postage enclosed for pounds.

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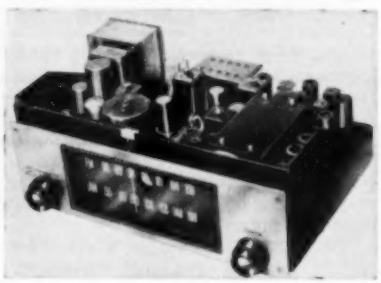
WHAT'S New in Radio

For additional information on any of the items described herein, readers are asked to write direct to the manufacturer. By mentioning RADIO & TELEVISION NEWS, the page and the issue number, delay will be avoided.

AM-FM TUNER

The Sargent-Rayment Co., 1401 Middle Harbor Road, Oakland, California is offering a new "building block" series of high-fidelity components, one of which is the SR68 AM-FM tuner.

The tuner has two AM positions permitting sharp or broad tuning. In the "broad" tuning position response is flat from 15 cycles to 9 kc. ± 1 db with a 10 kc. filter in the circuit



(measured at 1000 kc.). In the "sharp" tuning position response is limited to 5 kc. to permit reception of rural or hard-to-receive stations. The unit also features two-position FM, with or without a.f.c. Better than 5 μv. sensitivity is achieved on both AM and FM with at least 30 db of quieting on FM.

Since all of the company's equipment is designed to be used in any combination the user desires, the physical dimensions and housing of the AM-FM tuner follow the style of the other units.

A booklet covering all of the equipment in the "building block" series is available on request.

INSULATED TEST CLIPS

A new model of the company's nylon-insulated test clips is currently being offered by *Industrial Devices, Inc.* of Edgewater, New Jersey.

The Model #1410B (1)-(2) provides positive clip connection to all standard phone-tip test prods. The new units incorporate a phosphor bronze spring collar which accepts the standard prod with an electrically and mechanically positive grip. The clip is fully nylon insulated to allow shockproof, short-circuit proof operation in excess of 600 volts.

The clips are available in either red or black. The black is designated by the (1) while the red models are marked (2).

G-E TRANSISTORS

General Electric Company, Syracuse, New York has introduced a new hermetically-sealed junction transistor which is said to eliminate temperature and humidity restrictions which have prevented wide use of transistors in commercial and military electronic equipment.

The new transistor operates efficiently in temperatures as high as 212 degrees F and under the most adverse humidity conditions, according to the company.

Small quantities of the new transistor will be made available to development laboratories and engineering groups in the near future. The product will be mass produced at the company's germanium products plant at Clyde, N. Y. beginning this fall.

TRANSISTOR TRANSFORMERS

Standard Transformer Corporation, 3580 Elston Avenue, Chicago 18, Ill. is in production on a line of transistor transformers which weigh less than 1/10 ounce.

Although designed primarily for transistor audio applications, they can be used wherever low power is involved.

At the present five models are available: UM-110 interstage; UM-111 output or matching; UM-112 high impedance mike input; UM-113 interstage; and UM-114 output or matching.

A data sheet giving specifications on all these units is available from the company on request.

NEW BENDIX PACKSET

A new portable FM radio receiver-transmitter which weighs less than

10 pounds and provides increased power output per pound, is now in production at the Baltimore, Maryland plant of the *Bendix Radio Communications Division.*

Designed to operate in the 152-174 mc. band, the unit provides one watt of r.f. output and can be supplied for communication on either one or two channels.

An important feature of the new MRT-9 is the adjacent channel selec-

get out ahead in UHF

THESE PRACTICAL BOOKS GIVE YOU THE "KNOW-HOW"

"UHF ANTENNAS, CONVERTERS AND TUNERS"

Milton S. Kiver gives you all the answers on:

UHF Antennas: Full analysis of each UHF type—design, operation, directional characteristics, input impedance, gain—tells you type best suited for any given location and conditions.

Transmission Lines, Matching Networks: tells how to select proper line to deliver maximum signal to receiver.

Installation Practices: Practical advice on proper antenna location and routing of line to set; tells how to check for antenna mismatch, how to determine whether system is properly installed.

UHF Converters: Full analysis of all existing self-contained types, including turret tuner strips.

UHF Tuners: Covers tuner design and operation, ranging from parallel-wire to "butterfly" types—tells how they work.

This book keeps you ahead in TV, makes you a UHF expert, for extra profits. Get your copy today.

ORDER **UHF-1** *Only* **$1.50**

"UHF CONVERTERS"

Covers 21 Models

Be among the first to understand the design and operation of the new UHF converters and tuners. This book describes all the popular units and tells how they work with present VHF sets. Covers the following makes: Arvin, Crosley, Dumont, G.E., Mallory, Motorola, RCA, Raytheon, Regency, Sarkes-Tarzian, Standard Coil, Stromberg, Sutco, Sylvania. To stay ahead in TV, you'll want this essential book.

ORDER **UC-1.** *Only* **$1.00**

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Order from your Parts Jobber today, or write direct to Howard W. Sams & Co., Inc. 2203 E. 46th Street, Indianapolis 5, Ind.

My (check) (money order) for $ ..... enclosed. Send the following books.

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tivity characteristic which eliminates interference from transmissions on adjacent channels. The packset also employs a "power on" warning device which sets off a tone signal should the operator forget to turn off the power when the set is not in operation.

Complete specifications and performance data are available from the company.

PHILCO TEST EQUIPMENT

The Accessory Division of *Philco Corporation*, Philadelphia 34, Pa. is currently introducing three new instruments in its line of test equipment for the service technician.

Now available are the Model 7052 mutual conductance dynamic tube checker, the Model 7053 cathode-ray tube checker, and the Model 7020 3-inch oscilloscope.

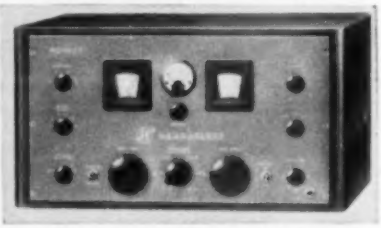
The Model 7052 tests and measures mutual conductance of tubes including miniature, subminiature, and low-power transmitting tubes; provides a means of forecasting remaining tube life; checks shorts and leakages between elements; and determines noise characteristics.

The Model 7053 for cathode-ray tubes checks the action of the electron gun using a neon lamp to indicate shorts and open elements in the electrodes of the gun.

The scope, Model 7020, is adaptable to either bench or field use. The vertical deflection amplifier is a wide-band, d.c.-coupled, highly-sensitive amplifier. The sweep oscillator has, in addition to its variable sweep ranges, four preset sweep frequencies for black and white and frame sequential color television servicing.

COMMUNICATIONS RECEIVER

Hammarlund Manufacturing Company, Inc., 460 W. 34th Street, New York 1, N. Y. has introduced a new, general-purpose superheterodyne com-



munications receiver, the "HQ-140-X", for use by commercial and amateur radio operators and short-wave listeners.

The receiver is a table-top model with continuously tunable frequency coverage from 540 kc. to 31 mc. in six bands and includes a self-contained power supply.

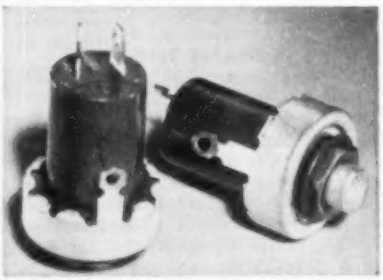
Bandspread tuning is available on the four higher frequency ranges with direct calibration for the 80, 40, 20, 15, and 10 meter amateur bands.

WATERSEALED JACKS

P. R. Mallory & Co., Inc., 3029 E. Washington Street, Indianapolis 6, Ind. has announced the development of two new watersealed jacks, the types WS-1A and WS-A2B.

The new units can be used in many types of communications systems where rapid electrical connections must be made by the use of phone plugs and which are subjected to high humidity conditions.

The Type WS-1A is a phono jack with terminals for one circuit and



ground. The WS-A2B is a microphone jack with terminals for two circuits and ground. Dielectric strength of the new jacks is 500 volts r.m.s. with contact resistance of .02 ohm maximum. Insertion force is approximately 6 pounds.

CROSSOVER NETWORK

British Industries Corporation, 164 Duane Street, New York 13, N. Y. is currently marketing a new three-way crossover network, Model HS/CR/3,

(*Continued on page* 98)

SPECIAL BUYS!

WOBULATOR
BUILD TV-FM-AM SWEEP GENERATOR
You can build "Versatile Sweep Frequency Generator" with APN-1 magnetic units $5.95
BC-1206 Beacon Receiver ... 200-400KC .. $ 9.95
MN-26L8 Receiver exc. $9.50
RCA Sound Powered Phones ... brand new . 12.95
pair 24.95
R44/ARR-5 Receiver 119.50
TS3/AP ... S-Band Power Frequency Meter 195.00
TS-184/AP Test Set 69.50
APR-2 Radar Search Receiver, 85-1000MC ... 195.00
APR-4 Radar Search Receiver, 38-4000MC ... 450.00
TS100 Oscilloscope 175.00
IE 19A-SCR522 Test Unit 295.00
MG-153 Inverter ..... Used 89.50

MIKES and HEADSETS
HS-33 Low Impedance Headset, exc. $2.95 new $5.95
HS-23 Headset ... used $2.95 new $4.95
CD-307 Ext. cord for HS 23-33 ... like new .79
Throat Mike—T 30 ... New .98
Lip Mike—Navy Type ... New .98
Extension Cord and Switch Assembly for lip and throat Mikes ... New .98
CW 49505 High Impedance headset complete with leather headband and rubber cushions. Used 98c
HS-18 Headset ... used $1.29 new $1.98
HS-38 ... exc. 1.95 new 2.29
HS-30, miniature headset ... used 1.49 new 2.49

DYNAMOTORS
The best dynamotor for conversion to 6v. Multiple windings! After conversion you get choice of 190 or 350 v. at 50 MA or 250 v. at 100 MA. Complete dope sheet furnished.
BRAND NEW (See "CQ" Aug. issue) $4.65

Surprise Package!
SURPRISE PACKAGE. 15 lbs. of assorted good radio parts. A real value at $1.95

RT7/APN1 TRANSCEIVER UNIT—Used as an altimeter, it may be converted for signaling control circuits, etc. Complete with 14 tubes and dynamotor they are in good used condition at the amazingly low price of $29.95
Used, less tubes, as is 4.95

MISCELLANEOUS EQUIPMENT
FL 8 used, exc. ... $1.19 BC 347 each ... used 95c
BC 906 each 9.95

YE-4B
General Electric Delay Line Unit 1000 ohms + or — 10% band pass 0 — 2 mc; 4 micro-second delay time. Brand new $1.98

SELSYN TRANSMITTER
Autosyn Transmitter Assembly for matching to I-82 Indicator. Used, excellent condition.
ONLY $10.95. Complete with Indicator ... $19.95

RL-42 Reversible Motor with antenna reel and clutch, used ..... $ 2.95
BC-433 RADIO COMPASS RECEIVER, 200 to 1700 KC, used, excellent condition, with tubes 39.95
used, exc., less tubes 24.95
used, as is, less tubes and cover, exc. for parts 9.95

Shipments F.O.B. warehouse. 20% Deposit on orders. Minimum order $5.00. Illinois residents, add regular sales tax to remittance.
Prices subject to change without notice.

BROADCAST BAND & AERO
Ideal for Use in Boats, etc.

MN-26-C Remote Controlled Navigational Direction finder and communications receiver. Manual DF in any one of three freq. bands, 150 to 1500 KC. 24 V. Self contained dynamotor supply. Complete installation, including receiver, control box, loop, azimuth control, Left-Right Indicator, plugs, Loop transmission line and flex. shafts.
BRAND NEW $89.50
LIKE NEW $69.50
MN-26-Y 150 to 325 KC, 325 to 695 KC, 3.4 to 7 megacycles, comp. installation $69.50
Receiver alone 39.95
MN-26-C alone, like new 39.50
MN-26-C or MN-26-Y as is less tubes 13.95
With tubes. Used good 24.95
MN-26-E Loop, Brand New 9.95
MN-52 Crank drive, New 3.50

TS10 TEST UNIT
Complete with attenuator, indicators and 350 feet of coaxial cable. Original cost $300.00. New Condition. ONLY $14.95

SCR-274N COMMAND and ARC-5 EQUIPMENT

	AS IS	EXC. USED (With tubes)	NEW
BC-450 Control Box (3 Receiver)	....	$1.95	$3.95
BC-456 Modulator	$2.95	4.95	....
BC-457 Control Box (Transmitter)	....	1.95	3.95
BC-442 Relay Unit ANT With Condenser	....	3.95	....
Without Condenser	....	1.29	2.95
Flexible Shafting with Gear to fit receivers	....	....	2.45
3 Receiver Rack	....	2.29	2.98
2 Transmitter Rack	....	2.39	3.97
Single Transmitter Rack	....	2.25	2.95
DM-32 Dynamotor for Command Set	....	3.25	9.95
DM-33 Dynamotor for Command Set	....	2.95	3.95
Shock Mts. for 3 Receiver Rack, 2 Trans. Rack, Modulator or Ant. Relay Unit	....	1.95	2.45

BC457 TRANSMITTER—4 to 5.3 mc and
BC458 TRANSMITTER—5.3 to 7 mc and
BC455 RECEIVER—6 to 9 mc (as is, less tubes and crystals) ..... ONLY $4.95 each
Any two units for $8.95

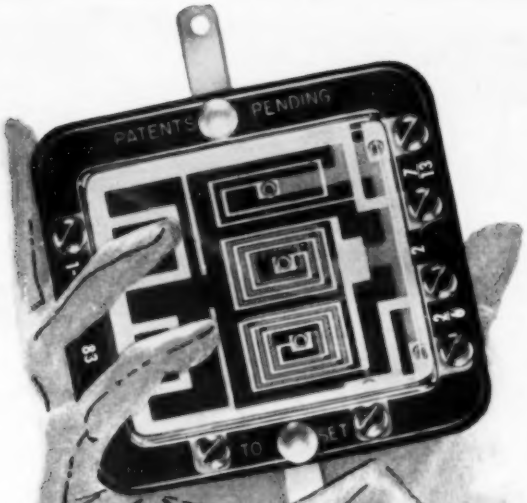
HAND SETS
TS9, excellent condition $4.95
TS13, excellent condition 5.95
TS Type, exc., less cord 2.95

WANTED!
All TS, APR, APS, ARC, ARN, ART, SCR, R89 and BC equipment . . . write today!
Quote lowest prices in your first letter

RT/34 APS 13 Transceiver used as a tail warning radar on 415 MC. Containing a 30MC IF Strip and various other parts, these units have been stripped of RF sections and all tubes, but are an excellent buy if only for parts and IF Strip ..... used $ 4.95
BC 624 receiver (SCR 522), less tubes, 100-156MC ..... used 14.95

"MONTHLY SPECIAL"
TRANSCEIVER—140-144 mc, 2 meter, used, excellent condition, less dynamotor, less tubes ..... only $17.95

R W ELECTRONICS
Dept. N, 1712-14 S. Michigan Ave., Chicago 16, Ill.
PHONE: HArrison 7-9274



JETENNA • JET 283 and now . . .

JFD introduces the revolutionary

JeTie Coupler, Q283

for VHF and UHF antennas

first of its kind!

- *joins one UHF and one VHF antenna*
- *joins two VHF antennas*
- *joins two VHF antennas and one UHF antenna*

. . . all with only ONE down-lead!

JFD Electronics

JFD gives you a direct line to profits with the amazing new JeTie coupler. Here's "single transmission line" reception on such disparate channels as 4 and 61—a miracle of engineering know-how that will pay off for you in countless sales. Made with a new silver printed circuit for ideal conductivity, the JeTie is hermetically sealed in a transparent moisture-resistant, dust-proof Butyrate case—the only one of its kind. Light weight, easy-to-attach, the JeTie coupler is the easy-to-sell answer to the new UHF and VHF stations in your territory.
LIST PRICE $5.30

For more information on the JFD JeTie, write to JFD Manufacturing Company, Inc

Brooklyn 4, New York
Bensonhurst 6-9200
World's largest manufacturer of TV antennas and accessories

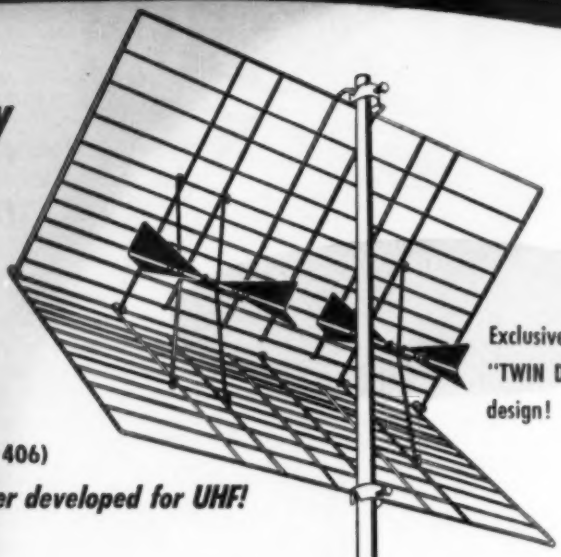
Barton broadcast advertising

Two heads are better than one!

And that's exactly why CHANNEL MASTER'S amazing new

Twin Corner Reflector (Model No. 406)

is the most sensitive fringe-area antenna ever developed for UHF!



Exclusive "TWIN DIPOLE" design!

TWO DIPOLES—HIGHER GAIN

The two dipoles of the Twin Corner Reflector provide TWICE as much gain as standard-type Corner Reflectors!

This two-dipole construction is an original Channel Master idea which successfully combines two separate Corner Reflectors into *ONE ANTENNA STRUCTURE* — requiring ONE simple installation.

This 2-in-1 combination gives you:

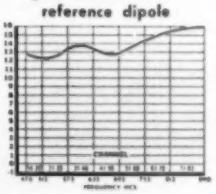
. . . the economy of one antenna.
. . . the convenience of one antenna.
. . . BUT the combined performance of TWO separate high gain antennas.

Model No. 406 furnishes far better picture quality — at far greater distances — on every UHF channel.

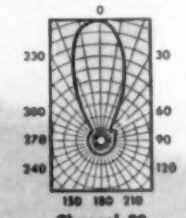
Eliminates UHF's "Twin Terrors." 100% vibration-proof construction prevents picture flicker. "Free space" terminals prevent dirt and rain water from shorting out the picture.

up to 16 DB gain

gain above tuned reference dipole



horizontal polar pattern (relative voltage)



Channel 20

Extremely narrow "Yagi-type" forward lobe; no side lobes; very high front-to-back ratio.

2 antennas in 1

The Twin Corner Reflector furnishes the performance of 2 antennas because it really is 2 separate antennas . . .

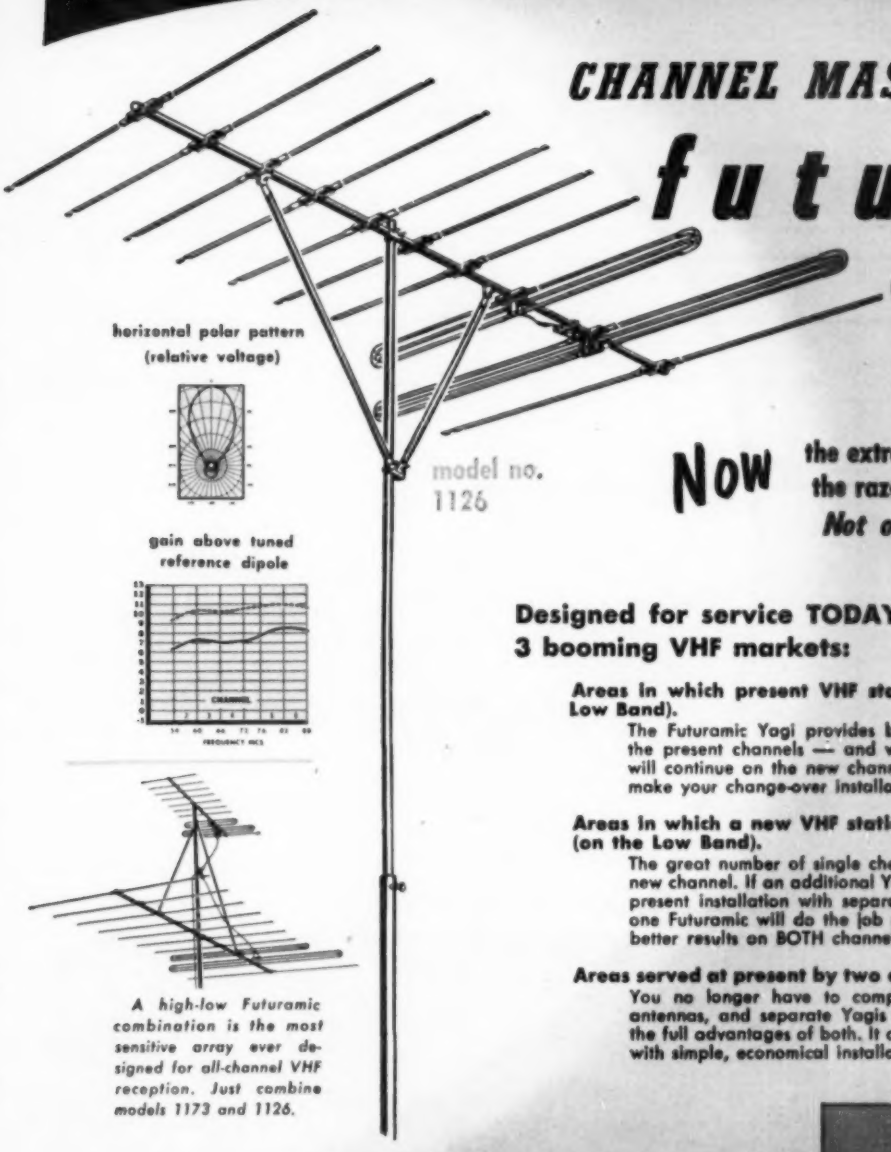
stacked side by side . . .

into 1 simple structure . . . with just a single downlead to the set.

CHANNEL MASTER engineering pays off on UHF!

CHANNEL MASTER CORP.
ELLENVILLE, N. Y.

At Last! a YAGI for the ENTIRE LOW BAND!



model no. 1126

CHANNEL MASTER'S Newest futuramic

Completely covers every low band channel— 2 through 6

horizontal polar pattern (relative voltage)

gain above tuned reference dipole

A high-low Futuramic combination is the most sensitive array ever designed for all-channel VHF reception. Just combine models 1173 and 1126.

NOW the extraordinary high gain of a Yagi . . . the razor-sharp directivity of a Yagi . . . *Not on just one channel — but clear across the entire Low Band!*

Designed for service TODAY and TOMORROW in these 3 booming VHF markets:

Areas in which present VHF stations are changing channels (on the Low Band).

The Futuramic Yagi provides better reception than conventional Yagis on the present channels — and when the shift occurs this superior reception will continue on the new channel WITHOUT INTERRUPTION. And you can make your change-over installations NOW.

Areas in which a new VHF station is being added to the present one (on the Low Band).

The great number of single channel Yagis now in use will not bring in the new channel. If an additional Yagi is installed it will have to be tied into the present installation with separate leads and a switching system. However, one Futuramic will do the job of BOTH antennas — at lower cost — with better results on BOTH channels.

Areas served at present by two or more VHF stations on the Low Band.

You no longer have to compromise between conventional broad band antennas, and separate Yagis for each channel. The Futuramic gives you the full advantages of both. It combines highest gain and sharpest directivity with simple, economical installation.

Now — 6 great Futuramic models, designed for every reception area:

model no.	channels covered	list price
1173	7 — 13	$20.83
1124	2, 3, and 4	
1125	2, 3, 4, and 5	
1136	3, 4, 5, and 6	$40.97
1146	4, 5, and 6	
1126	2, 3, 4, 5, and 6	

CHANNEL MASTER engineering pays off on VHF!

CHANNEL MASTER CORP. ELLENVILLE, N. Y.

H.V. FILAMENT XFMR

NO. FT-38A—
PRIMARY: 115V 60 CY. 1 PH.
SEC.: 2 WDGS. 2.5V AT 7 AMPS EACH, AND 1 WDG. 6.3V @ 2.5A TESTED AT 7500 VDC BETWEEN ALL POINTS.
HERM. SEALED. SIZE: 5½" H x 3½" D x 4" W. HAS 4 STUDS, ½" L on 3⅛" x 3" CENTERS.
AS SHOWN $2.79

BAND PASS FILTERS

INPUT IMPEDANCE: 3000 OHMS. OUTPUT: TO GRID. AVAILABLE IN FOLLOWING RANGES:

CHANNEL	Fr.	F1*	F2*
5	1155	830	1620
7	2270	1620	3180
8	3180	2270	4450
9	4450	3180	6230
10	6230	4450	8720

* Fr.: Center Freq. in CPS; F1 and F2 are lower and upper limits (CPS) respectively, at –20 db points.
Price, $4.95 Each

DYNAMOTORS

Type	Input Volts	Input Amps	Output Volts	Output Amps	Radio Set
PE86	28	1.25	250	.090	BC 36
DM416	14	6.2	330	.170	RU 19
DM33A	28	7	540	.250	BC 458
PE1616	12/26	12.6	400	.135	SCR 515
		6.3	800	.020	
80 AR 03	28	3.25	375	.150	
23250	27	1.75	285	.075	APN-1
ZA0615	12/24	4/2	600	.050	
8-19 pack	12	9.4	275	.110	MARK 11
			500	.050	
DA-3A	28	10	300	.060	SCR 522
			150	.010	
			14.5	.5	
5053	28	1.4	250	.060	APN-1
PE73CM	28	19	1000	.350	BC 375
CW21AAK	11	12.6	400	.125	
	28	6.3	800	.020	
			9	1.12	
PE94	28	10	300	.300	SCR 522
			150	.101	
			14.5	.5	

INVERTERS

PE-218-H: Input: 25/28 vdc, 92 amp. Output: 115 v, 350/500 cy 1500 volt-amperes. New $44.50

PE-206: Input: 28 vdc, 38 amps. Output: 80 v 800 cy, 500 volt-amps. Dim: 13"x5½"x10½". New $22.50

LELAND No. 10536: IN: 28 VDC, 12A. OUT: 115V, 115VA, 400 CY 3 PHASE. EXC. COND $10.00

RECTIFIER TRANSFORMERS

Pri: 115V, 60 Cy. Sec: 28V/3.1A, 26V/8.4A, 7.3V/14A $12.95

Pri: 210/215/220/225/230/235/240V, 60 Cy., 1 Phase. Sec: 11/10/7.5/5VCT @ 35A $10.50

Pri: 115V 60 Cy. Sec: 8.1V @ 1.5A $1.39

Pri: 115V 60 Cy. Sec: 18.5V @ 5A $2.79

APN-4 COILS

352-1386 ..... $0.49 352-1549 ..... $1.00
352-1389 ..... $0.49 352-1550 ..... $1.00

EE-89 REPEATER

Extends range of EE-8 field phone up to 20 miles of dry or wet wire operation. Extremely rugged, portable and lightweight. Uses hybrid coils and V. T. Amplifier, with extreme long-life characteristics.
Brand New, Complete With Tube & Tech. Manual, only ..... $12.75 each

HELMHOLTZ PHASE-SHIFTER

Stator consists of 4 loops oriented at 90 degrees to each other. Total stator inductance is 40 MH. rotor: 10MH. total phase shift 0-360 deg. Designed for range unit of SCR-268..... $3.95 each

BIRTHER TUBE CLAMPS

926B-16	926C-19	926C-24
926B-15	926C-15	926K-2

PRICE: 18c EACH OR–$16.50/100

SUPERSONICS

MODEL M1-2 CRYSTAL HEAD: Consists of mosaic of 3 crystals encased in oil-filled disk approx. 4" diam., 1" thick. Entire assembly is attached to ½" mtg. flange. Frequency: 17-27KC. Approx. 50 watts out. Completely watertight.....$27.50

MODEL JR HYDROPHONE: Rubber sheath 4' long, 4" diam., in which is enclosed a lattice of 7 crystals and 50-ohm matching transformer. The sheath is filled with mineral oil for acoustic damping. Frequency: 22-32 KC $24.50

Send M.O. or Check. Shipping Chgs. C.O.D.
COMMUNICATIONS EQUIPMENT CO.
131 Liberty St. Dept. N-6 New York City 7, N. Y.

G-E's INTERNAL MAGNETIC FOCUS SYSTEM

Improved TV set performance is anticipated with the use of these new permanent, factory-focused picture tubes.

THE development of an "internal magnetic focus" gun which will permit the elimination of the external focus coil and ion trap magnet on television picture tubes has been revealed by *General Electric Company's* Tube Department.

Use of the new gun is said to make possible sharper picture definition across the entire face of television screens.

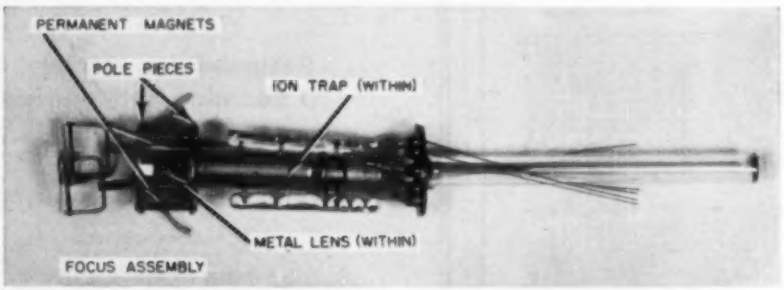
The elimination of the necessity for manufacturers to add a focus coil, ion trap, or bulky mounting brackets to picture tubes will mean a major saving in parts and assembly operations.

The new gun contains an internal compensating focusing lens which maintains focus over a wide range of operating voltages. A simple shunt may be used to increase this range. No external focus control requiring set-owner adjustment is necessary, according to spokesmen for the company.

The focusing and ion trap devices in the new gun employ four tiny *Carboloy* "Alnico 5" magnets made of the most powerful permanent magnetic material now being produced. Three of the magnets, measuring a quarter of an inch in diameter and five-eighths of an inch in length, are used in the focus assembly and the fourth, measuring one-eighth of an inch in diameter and length, is used in the ion trap unit.

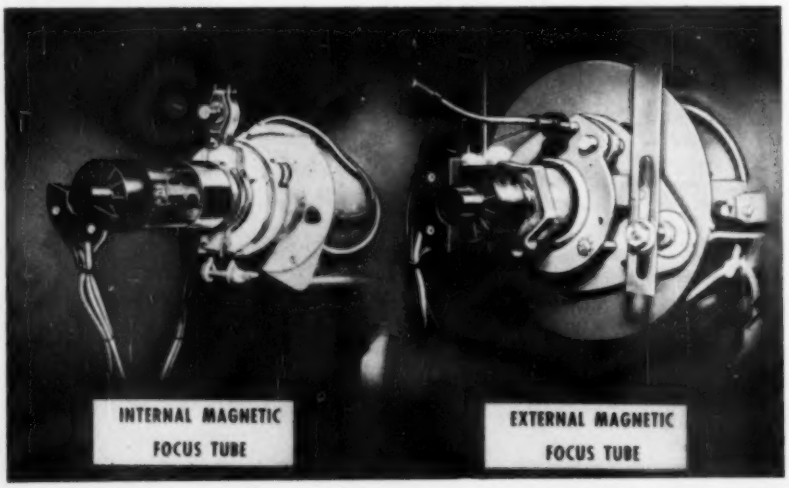
Tubes incorporating the new "internal magnetic focus" feature (i-m-f) are permanently focused at the factory for optimum viewing. The focus quality is said to be higher than that found in present electrostatic tubes and at least equal to that obtained with magnetic-focus tubes.

—30—

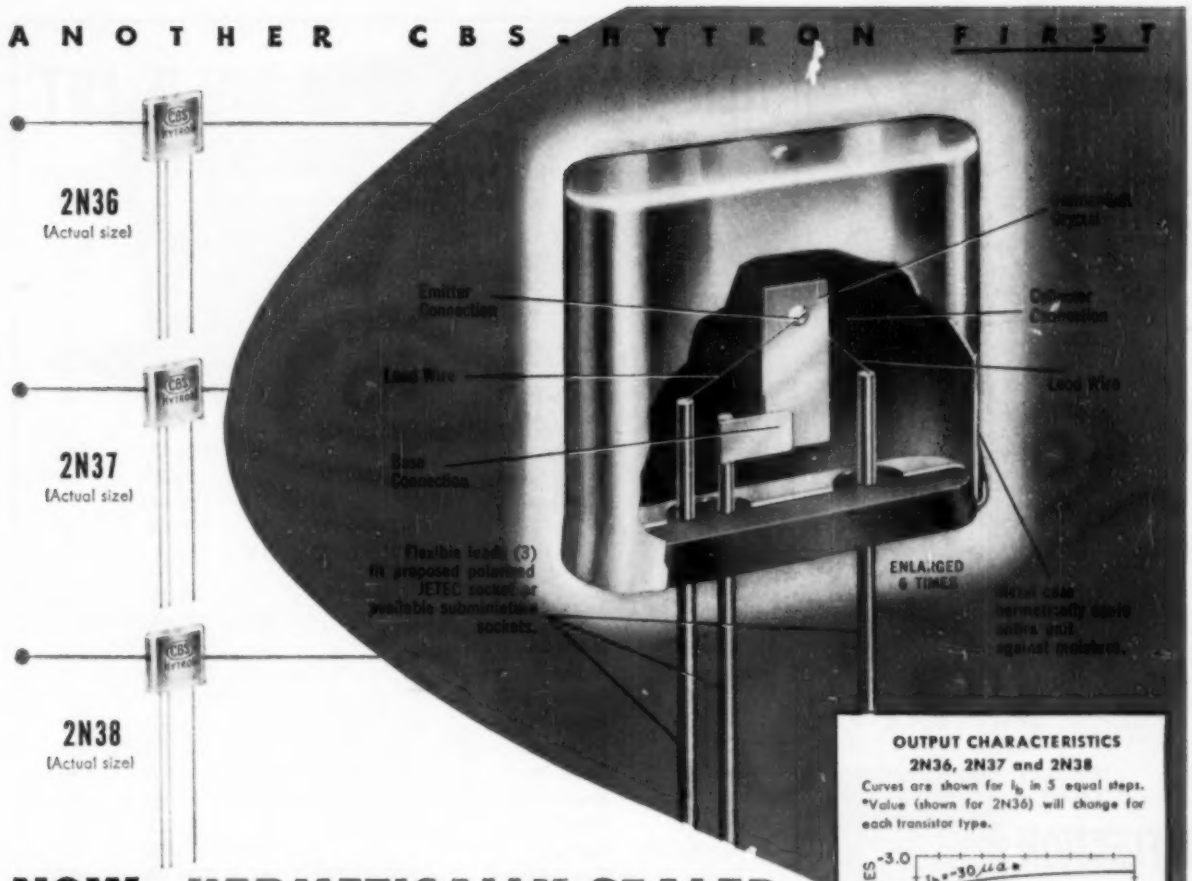


Gun structure used in General Electric's "internal magnetic focus" picture tubes.

Simplicity of installation is demonstrated using the two types of guns as examples.



A N O T H E R C B S - H Y T R O N F I R S T



NOW...HERMETICALLY SEALED CBS-HYTRON JUNCTION TRANSISTORS

In junction transistors, the surfaces are extremely sensitive to moisture. For dependability, they must be completely moisture-proofed. CBS-Hytron, recognizing this, is the first to offer you the new *hermetically sealed* 2N36, 2N37, and 2N38 junction transistors. Each is uniquely sealed in a metal case . . . moisture-proof, contamination-proof, light-proof. (See drawing.)

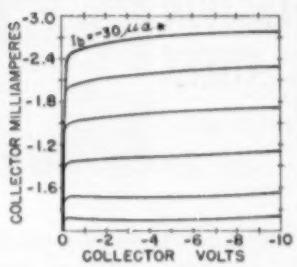
You can buy these new hermetically sealed P-N-P junction types immediately. All are amplifier types. Have similar characteristics, except for current amplification and power gain. You may operate the 2N36, 2N37, 2N38 up to 55°C. Their in-line design gives you: Compact, flat mounting . . . easily identified polarity . . . solder-in or plug-in (with clipped leads) convenience.

In addition to their unique moisture-proof feature, these CBS-Hytron junction types offer: (1) High gain. (2) Low noise figure. (3) Operation at low voltages. As well as other advantages characteristic of transistors: Compactness . . . light weight . . . ruggedness . . . instantaneous operation . . . and long life.

Remember, CBS-Hytron hermetically sealed 2N36, 2N37, 2N38 transistors are available at once. Write for complete data. Or order now for prompt delivery.

OUTPUT CHARACTERISTICS
2N36, 2N37 and 2N38

Curves are shown for I_b in 5 equal steps. *Value (shown for 2N36) will change for each transistor type.



ELECTRICAL CHARACTERISTICS†
CBS-Hytron P-N-P Junction Transistors

Characteristic	2N36	2N37	2N38	
Collector voltage	—6	—6	—6	v
Collector current	—1	—1	—1	ma.
Current amplification factor ƒ	45	30	15	
Power gain ƒ	40	36	32	db

†Typical values at 25°C. ƒGrounded emitter connection.

NOW 3 CBS-HYTRON TEST ADAPTERS. By popular demand. Three sizes now available at these net prices: 7-Pin Miniature, $1.45; 8-Pin Octal, $2.25; 9-Pin Miniature, $1.75. Take advantage of e-a-s-y "topside" testing. Order your Test Adapters today from your CBS-Hytron jobber.

CBS HYTRON
Manufacturers of Receiving Tubes Since 1921

CBS-HYTRON Main Office: Danvers, Massachusetts

A Division of Columbia Broadcasting System, Inc.

RECEIVING . . . TRANSMITTING . . . SPECIAL-PURPOSE AND TV PICTURE TUBES • GERMANIUM DIODES AND TRANSISTORS

are you

BURNED UP?

TRIAD DEFLECTION YOKES

will cool you off

If you are tired of blasting cooked yokes off of picture tubes—then switch to Triad Deflection Yokes. They have a molded high-temperature plastic insulation between vertical and horizontal coils, reducing chances of cooking and simplifying servicing. Triad's new 1953 Catalog features 18 new items which have been added to an extensive line of TV replacements—every item designed for long trouble-free service, and to ease and speed the serviceman's job.

Write for Catalogs TR-53A and TV-53A

TRIAD TRANSFORMER CORP

4055 Redwood Ave. • Venice, Calif.

NEW TV GRANTS SINCE FREEZE LIFT

Continuing the listing of construction permits granted by FCC since lifting of freeze. Additional stations will be carried next month.

STATE	CITY	CALL**	CHANNEL	FREQUENCY (mc.)	POWER (Video)*
Arizona	Yuma	.....	11	198-204	29
California	Chico	KHSL-TV	12	204-210	12.3
"	San Diego	KFSD-TV	10	192-198	316
"	San Francisco	.....	20	506-512	94
"	San Luis Obispo	KVEC-TV	6	82-88	20
"	Yuba City	KGAR-TV	52	698-704	91
Delaware	Dover	.....	40	626-632	195
Florida	Fort Myers	WINK-TV	11	198-204	9.6
"	Panama City	.....	7	174-180	10.5
Georgia	Columbus	WDAK-TV	28	554-560	89
"	Warner Robins (Macon)	WMAZ-TV	13	210-216	300
Idaho	Nampa	KFXD-TV	6	82-88	19.5
Illinois	Bloomington	.....	15	476-482	18
"	Harrisburg	.....	22	518-524	10.5
Indiana	Indianapolis	.....	26	542-548	95
"	Indianapolis	.....	67	788-794	125
"	Marion	WMRI-TV	29	560-566	15
"	Princeton	WRAY-TV	52	698-704	95
Iowa	Davenport	.....	36	602-608	15
"	Des Moines	.....	17	488-494	180
Maryland	Salisbury	WBOC-TV	16	482-488	110
Massachusetts	Boston	.....	50	686-692	255
"	Cambridge	WTAO-TV	56	722-728	20
Minnesota	Austin	.....	6	82-88	18.5
"	St. Paul	WCOW-TV	17	488-494	180
Mississippi	Columbus	WCBI-TV	28	554-560	210
Montana	Missoula	KGVO-TV	13	210-216	11
New Mexico	Albuquerque	KGGM-TV	13	210-216	89
"	Clovis	.....	12	204-210	10.2
New York	Rochester	WHEC-TV	10	192-198 (will share channel with WVET-TV)	118
"	Rochester	WVET-TV	10	192-198	118
North Carolina	Greenville	WNCT	9	186-192	100
"	Hendersonville	WHKP-TV	27	548-554	20
"	Mt. Airy	WPAQ-TV	55	716-722	21
North Dakota	Bismarck	KFYR-TV	5	76-82	100
"	Bismarck	.....	12	204-210	60
Oregon	Medford	.....	5	76-82	19
Pennsylvania	Chambersburg	WCHA-TV	46	662-668	105
Tennessee	Knoxville	.....	26	542-548	21
Texas	Fort Worth	.....	20	506-512	270
"	Lufkin	KTRE-TV	9	186-192	11
"	Sherman	.....	46	662-668	20.5
"	San Antonio	.....	35	596-602	230
"	Victoria	.....	19	500-506	20
Virginia	Harrisonburg	WSVA-TV	3	60-66	12.5
West Virginia	Charleston	WKNA-TV	49	680-686	228
Utah	Salt Lake City	.....	2	54-60	27.5

*ERP = (effective radiated power). **Call letters without TV suffix from application files and subject to change; except where included in calls such as KKTV or WTVT. .. = Call letters to be announced

World's most powerful TV ANTENNA!

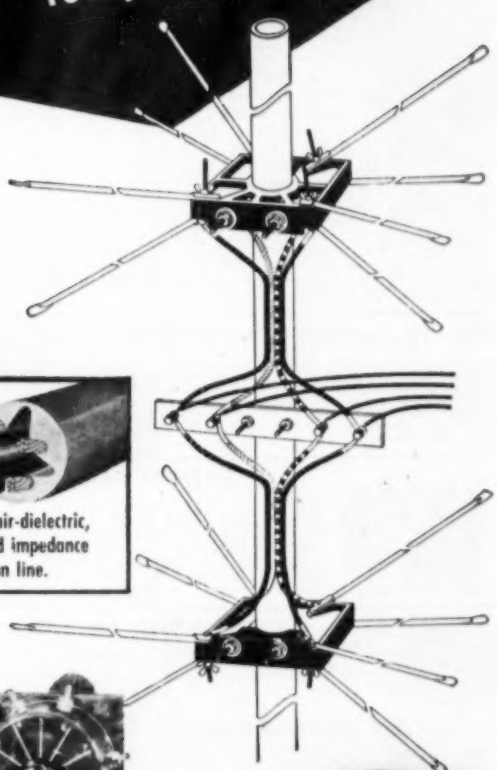
22 Db gain

over tuned dipole!

motorless all-direction
UHF-VHF-FM
reception

MONEY BACK GUARANTEE

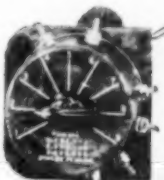
to outperform all other antennas using rotor motors on
UHF—VHF & FM



- Guaranteed 10 times more powerful than stacked 10 element Yagis.
- Receives channel 2-83 from all directions without a rotor.
- Broadband UHF-VHF and FM, motorless all direction reception.
- All aluminum flip-out assembly.

Four conductor air-dielectric, tubular, matched impedance transmission line.

The only TV antenna that instantly beams the television set directly to the signal without a rotor. This antenna brings strong UHF & VHF signals from all directions to weak signal areas instantly . . . with a flick of the nine position switch located near the television set.



MONEY BACK GUARANTEE To out-perform all other antennas (using rotor motors) on both UHF and VHF, including stacked ten element Yagis, stacked corner and bow-tie reflectors, four bay conicals, etc.

Model A D 2-8

Includes Stacked Antenna Array. 9 Position Switch. Completely Wired Stacking Harness. A.I.M.—Automatic. Impedance Matching Coupler.

List Price
$36.50

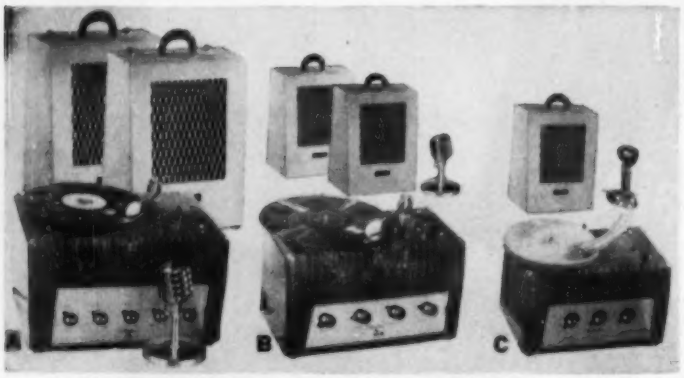
see us at....

THE ELECTRONIC PARTS SHOW, CHICAGO ROOMS 647A & 648A

ALL CHANNEL ANTENNA CORP.

70-07 Queens Blvd.,
Woodside 77, N.Y. Hickory 6-2304

AMERICA'S FINEST 28 WATT—50 WATT AND 10 WATT P.A. VALUES



$69.95 BUYS A 28 WATT $150.00 LIST VALUE PORTABLE P.A. SYSTEM

(Illustration B)

3-SPEED PHONO TOP—TWO 12-INCH SPEAKERS
7-TUBES PUSH PULL 6L6'S HEAVY LEATHERETTE COVERED PLYWOOD PORTABLE CASES
CRYSTAL MIKE $8.95 EXTRA

STOCK No. AP-28X. Portable 28 watt public address system. You get a 7-Tube heavy duty push-pull 6L6 amplifier with inputs for 2 mikes either crystal or dynamic with separate mixing volume controls. One phono input. Fully variable tone control high fidelity, wide range frequency response. The heavy duty output transformer has taps for 4, 8, 16, 125, 250 and 500 ohm speaker connections. Two heavy duty 12 inch alnico V P.M. speakers, each with 25 feet of speaker cable. Each speaker is mounted in separate carrying cases. Each case has a snap on back and is large enough to give good speaker baffling. Each case is 21 x 16 x 13 inches. One is used to carry the amplifier. A 3-speed phono motor and pick-up is mounted in the top of the amplifier to play 33⅓, 45 and 78 RPM records.

This portable PA system will put out 20 watts all day long and 28 to 30 watts peak audio. McGee offers you this $150.00 list portable PA system at a terific saving.

STOCK No. AP-28X complete portable PA system with 3-speed phono and speakers as pictured (less mike) ship. wt. 71 lbs. **$69.95.**

Electro Voice model 910 $28.50 list crystal mike with 20 feet of cable and desk stand **$8.95** extra.

Floor type mike stand instead of desk stand **$4.95** extra.

50-WATT PORTABLE P.A. ON SALE $99.95
3-SPEED PHONO TOP—TWO 12" SPEAKERS

(Illustration A)

10-tube portable 50-watt public address system. 4—6L6G (push-pull parallel) output tubes. Inputs for 2 microphones, either crystal or dynamic, with separate mixing volume controls. Twin bass and treble tone controls. High fidelity wide range output transformer with taps at 4, 8, 16, 125, 250 and 500 ohms. Complete with 2 super heavy duty 12" PM speakers and 25 ft. cables mounted in separate leatherette-covered carrying cases, 21"x21"x13". The amplifier fits in one of the cases for carrying. This amplifier will put out 40 watts all day long and 50 to 60 watts peak with ease. 3-speed turntable and pickup arm to play all records 33⅓, 45 and 78 RPM is mounted in the top of the amplifier. Stock No. AP-60X, 50 watt portable P.A. system similar to the 28-watt model pictured above, less microphone. Sale price, **$99.95.** Shipping weight, 100 lbs. Shipped via Express or Truck only. Regular $45.00 list Electro-Voice 610 dynamic microphone with 20 ft. cable and desk stand, **$11.95** extra. For floor stand instead of desk stand, add **$4.95.**

10-WATT PORTABLE P.A. ON SALE $42.95
3-SPEED PHONO TOP—10" ALNICO PM SPEAKER

(Illustration C)

5-tube portable 10-watt (14-watt peak) public address system. (Push-pull 7C5) U. L. approved amplifier with wide ranger response. Inputs for microphone and phono, with separate mixing type volume controls. Tone control. 10" Alnico V PM speaker is housed in a leatherette case 21"x16"x13" which holds the amplifier for carrying. 3-speed turntable and pickup arm to play all records 33⅓, 45 and 78 RPM is mounted in the top of the amplifier. List value, $90.00. Stock No. AP-10X, 10-watt portable P.A. system has only one case and one 10" speaker, less microphone. Sale price, **$42.95.** Shipping weight 41 lbs. Shipped via Express or Truck only.
Crystal microphone with non-removable desk stand, **$3.95** extra when ordered with the AP-10X portable P.A. system.

BRUSH CRYSTAL EAR PHONE With Control $5.49

Simply clip on to the speaker voice coil of any radio or TV set or to an audio amplifier. No soldering necessary. Listen in privately to your favorite programs. The tiny Brush crystal ear phone fits your ear just like a regular hearing aid ear piece. A small remote control box enables using 20 ft. from the radio or TV set. Has its own separate volume control and small matching transformer built-in to operate the crystal from any speaker voice coil. Ideal for hospitals, homes, hundreds of other uses. 10 times more comfortable to wear than conventional earphones. Stock No. BH-500 includes Brush crystal ear piece, remote control box, 20 ft. of cable and instructions. Sale price, **$5.49** complete. Brush crystal earphone with 36" cord. Stock No. BR-51, **$2.95.** (You connect it like any crystal earphone, diagram furnished.) Accessory kit includes volume control with switch plus coupling capacity and instructions, **$2.95** extra.

INDIVIDUALLY CARTONED ELECTRONIC RADIO & TV TUBES

McGee offers you a wide selection of good quality TV and Radio tube types. Individually cartoned. Our private brand. These are not set mfg's. culls, but a carefully inspected private line of tubes with a full 6 months' guarantee. Types listed are in stock in good quantity at this time. Thousands sold. Order 50 tubes and take 10% off the listed prices.

0Z4	$0.59	6AT6	.49	6K7GT	.59	7Y4	.69
1A7GT	.59	6AU6	.49	6L6G	1.09	12AL5	.59
1B3GT	.79	6AV6	.49	6S4	.59	12AQ6T	.69
1H5GT	.59	6AX4GT	.69	6SA7GT	.69	12AT6	.69
1L4	.59	6BA6	.49	6SH7GT	.59	12AT7	.69
1R5	.59	6BA7	.69	6SF5GT	.59	12AU6	.59
1S5	.59	6BC5	.69	6SK7GT	.59	12AU7	.59
1T4	.59	6BD6	.49	6SL7GT	.69	12AV6	.59
1U4	.59	6BF5	.59	6SN7GT	.69	12AV7	.89
1U5	.59	6BF6	.59	6U7GT	.69	12AX4GT	.59
3Q4	.59	6BQ6G	1.29	6T8	.79	12AX7	.69
3Q5GT	.69	6BH6	.59	6U8	.79	12BA6	.59
3S4	.59	6BJ6	.59	6V6GT	.59	12BE6	.59
3V4	.59	6BK7	.99	6W4GT	.59	12BD6	.59
5U4G	.49	6BQ6GT	.99	6X4	.39	12BF6	.79
6AB4	.49	6C4	.39	6X5GT	.49	12KB8GT	.59
6AK5	.69	6C8G	.59	7A7	.69	12SA7GT	.59
6AL5	.49	6CD6G	1.49	7B6	.69	12SF5GT	.69
6AQ5	.49	6H6GT	.59	7H7	.79	12SJ7GT	.59
						12SN7GT	.69
						12SL7GT	.79
						19BG6G	1.79
						25BQ6GT	.99
						25L6GT	.59
						32L7GT	.79
						35B5	.59
						35C5	.59
						35W4GT	.39
						35L6GT	.59
						43	.79
						47	.89
						80BS	.59
						80CS	.59
						50L6GT	.59
						70L7GT	.99
						117Z3	.39

UHF TELEVISION CONVERTER $34.95

Sutco UHF television converter with built-in booster. Continuously variable for channels 14 thru 83. Built-in wide band VHF booster for channels 2 thru 13. Self powered for 110 volt, 60 cycle AC operation. Selector switch gives choice of VHF or UHF antenna. VHF antenna may be fed thru the broad band booster or direct to the TV set. Stock No. 21A, shipping weight 7 lbs. Net price **$34.95.**

REGENCY RC-600 $37.46

Carefully engineered and of highest quality construction. Features extreme stability, air dielectric in the tuning element, image rejection of VHF stations down 50 to 60 db. Converts all sets and is highly recommended for those having split sound and video. Tubes are 6AF4 oscillator, crystal diode mixer, 6BK7 dual triode IF amplifier and selenium rectifier. Front panel change-over switch for UHF or VHF. Input and output impedances 300 ohms. For 110 volt 60 cycle AC operation. Shipping weight 8 lbs. Stock No. RC-600, price **$37.46** each.

50-WATT BOOSTER AMPLIFIER

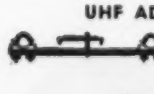
50-WATT BOOSTER AMP. $39.95

2-Mike Pre-Amp $12.95 Extra. Not a Kit, but a Manufactured Amp.

50-WATT BOOSTER A sensational value, 50 watt booster amplifier with push-pull parallel 6L6 output tubes. Connect to your present amplifier as a booster or use with the PR-2X Pre-amp to add the use of 2 mikes and one low level input. The booster amplifier has one input jack and with 1 volt input gives 50 watts of audio. Booster has a 6 lb. potted case high fidelity output transformer, matches speaker with 4-8-16 ohm voice coil, also 60 ohm and 250 ohm line. Booster has a 225 mill power supply with 5U4 rectifier. Price includes tubes: 4 6L6, 7N7 and 5U4. The two variable controls are for master volume control and bass boost tone control. Size 8 x 6½ x 14½. Stock No. PA-55N, Shipping weight 26 lbs. Sale price **$39.95** ea.

2-MIKE PRE-AMP. Pre-amplifier plugs in directly to the PA-55N Booster amplifier. It enables use of 2, Crystal or Dynamic Mikes plus one low level input. Furnished with 4 foot cables and plugs for remote control of the 55 watt Booster Amplifier. Small chassis size 5 x 3¼ x 4". Stock No. PR-2X, with tubes 7F7 and 7N7. Net price **$12.95** ea.

UHF-VHF ANTENNAS

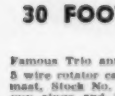


VEE-D-X Ultra Q-TEE. One antenna for all channels 2 thru 83 with a single transmission line (tubular 300 ohm recommended, your cost 4c per ft.) List price $14.25, your cost **$8.36.**
Two stack Ultra Q-TEE antenna for fringe area. List price **$29.95,** your cost **$17.58.**

UHF ADAPTING BRACKET

Permits addition of UHF antenna to existing VHF installation. Mounts three different ways to mast or antenna boom. List $1.50. Your Net Cost..... **88c**

VEE-D-X MIGHTY MATCH

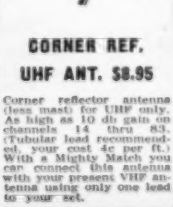


Model MM-30. Provides best method of combining VHF-UHF antenna systems with single transmission line. Automatic action. Printed circuit fit ers. List $4.00. Your Net Cost..... **$2.35**

30 FOOT TELESCOPING MAST $10.95

Famous Trio antenna rotator, Net **$26.43.**

5 wire rotator cable, 3c per foot. Deluxe 30 foot telescoping mast, Stock No. ST-30, $10.95. Complete kit of guy wire, guy rings and base mount for mast, $6.00 extra. Prices do not include Express charges.



CORNER REF. UHF ANT. $8.95

Corner reflector antenna (less mast) for UHF only. As high as 10 db gain on channels 14 thru 83. (Tubular lead recommended, your cost 4c per ft.) With a Mighty Match you can connect this antenna with your present VHF antenna using only one lead to your set.

McGEE'S $62.50 LIST 15" COAXIAL SPEAKER, $21.95
21 OZ. ALNICO V MAGNET—5" TWEETER

This is the finest 15" coaxial FM speaker value that we have ever offered. New 1953 production, of a famous manufacturer of fine speakers. The 15" speaker has a 21½ oz. Alnico V magnet, equal to 68 oz. of the Alnico 3 type magnet. The cone is free floating, of one piece construction. Will reproduce low frequencies down to 20 cps. The 5" tweeter is coaxially suspended and has a ridged cone to reproduce only the high frequencies. It will respond up to 17,500 cps. The high-pass filter is concealed under the pot cover, leaving only two wires to connect both the tweeter and woofer to any 8 ohm output transformer of a radio, or high fidelity music lover's amplifier. Stock No. P15-CR, shipping weight 13 lbs. Net price **$21.95.**

12" JENSEN PM, $15.95

Another McGee Scoop! Jensen Concert 19" 14½ oz. Alnico V magnet PM speaker, 4 ohm voice coil. Will take 25 watt audio. You save dollars on this speaker. Just 100 to sell. Shipping weight 8 lbs. Stock No. P-12P, Sale price **$15.95;** 2 for **$30.00.**

12" COAXIAL SPEAKER, $12.95

McGee offers the new 1953 model 12" coaxial PM speaker. Quality you would put in your finest sets if you were a manufacturer. 12" woofer has 6.8 oz. Alnico V magnet. Tweeter is coaxially suspended and has a metal diffuser. High pass filter is under the pot cover. Only two wires to connect to your radio or audio amplifier. 8 ohm with 18 watt peak and 10 w a t t average. Shipping weight 8 lbs. Response from 30 to 17,500 cps. Stock No. CT-14Y, Sale price **$12.95** each: 2 for **$25.00.**

G.I. 3-SPEED CHANGER WITH G.E. $22.95

VARIABLE RELUCTANCE TURN-ABOUT CARTRIDGE

Another tremendous McGee Scoop! Brand new General Instrument 3 speed automatic record changers. Complete with RPS-050 G.E. variable reluctance cartridge with turn-about stylus. Plays all 3 speeds automatically: 7", 10" or 12" records. Has reject button. Repeats last record. Base size, 12"x12¾". Shipping weight 14 lbs. Stock No. 700-GE. Scoop price. **$22.95.**

GI 3-speed changer same as above, but with Webster flip-over twin needle cartridge. Stock No. GI-700, Sale price, **$31.95** each.

McGEE RADIO COMPANY Prices F.O.B. K.C. Send 25% Deposit with Order, Balance Sent C.O.D. With Parcel Post Orders, Include Postage

TELEPHONE VICTOR 9045. WRITE FOR FLYER 1422 GRAND AVE., KANSAS CITY, MISSOURI

TELEVISION BOOSTERS AND CONVERSION KITS ON SALE AT McGEE

GENUINE STANDARD COIL T.V. BOOSTER $10.95

Not Surplus, But Right From the Factory

Latest Model B-51 Standard Coil Television Booster. McGee makes another lucky purchase and as usual, passes the saving on to you. The famous Model B-51, 12 Channel Standard Coil TV booster which lists for $35.00, is offered to you for only $10.95 each. Brand new, factory cartoned and fully guaranteed by McGee. This top quality single stage booster utilizes printed high frequency circuits, for improved performance on all channels. Uses 6AK5 tube. Average gain, 6 to 7 volts on low channels and 5 or 6 on high channels. No distorting of picture or sound. Has extremely low noise factor. Continuous one-knob tuning and channel selector control switch for off-on and by-passing 300 ohm lead-in to set. Modern design, dark brown plastic cabinet, 8"x4¼"x4½". Made for 110 volt, 60 cycle AC operation. Shipping weight 5 lbs. Model B-51, Sale price, **$10.95** each, or buy 2 for only **$20.00**.

FRINGE AREA TV RECEPTION IS BETTER WITH OUR McMURDO SILVER TV BOOSTER $10.95—TWO FOR $20.00

Read the article on pages 52 and 53 of the December "Radio & TV News." You will see how a booster like the McMurdo Silver Super Sonic was used for fringe area TV reception. We can't guarantee this unusual reception, but we will guarantee this booster to be a sensational value. Continuously variable inductance type tuner from channel 2 including the FM band through channel 13. Self-powered for 110 volts AC operation. Incorporates a 6J6 tube. Input for 300 ohm TV line and 300 ohm output to TV set. Single knob tuning. Attractive plastic case. McMurdo Silver Super Sonic TV-FM booster. Stock No. GB-6B, shipping weight 5 lbs. Sale price, **$10.95** each or two for **$20.00**.

20 INCH CONVERSION KIT $29.95

YOU GET—

20HP4—20" PICTURE TUBE
20-INCH PLASTIC MASK
14 K.V. FLYBACK AND 70° YOKE

Our 20" conversion kit includes a 6-month guaranteed 20HP4, 20° rectangular blackface picture tube, plus a 14,000 volt G.E. built high voltage flyback transformer, plus a matched 70° cosine yoke, plus a 20" rectangular gold trimmed plexiglas mask and suggested diagram. The picture tube is the latest electro-static focus type that requires no focus coil. Shipped via express or truck only. Ship. weight, 40 lbs. Stock No. 20-TP, net price, **$29.95**. Price with Raytheon or GE 1 year guarantee picture tube, **$10.00** extra.

14-Inch Conversion Kit WITH G.E. TUBE $25.95

14-inch conversion kit: You get a 14-inch black face, 1 year guarantee G.E. 14CP4 picture tube, a 70° deflection yoke with matching 14,000 volt G.E. flyback and a 14" plexiglas gold trim safety mask, plus conversion instructions. Stock No. 14CC-G, Sale price, **$25.95**.

17-INCH CONVERSION KIT $25.95

You Get—17BP4A 17" Picture Tube
17-Inch Plastic Mask
14 K.V. Flyback and 70° Yoke

17-inch conversion kit with a 17BP4A, 17" rectangular blackface electro-magnetic focus picture tube with 6 months' guarantee, plus a matched 70° cosine yoke, a G.E. built 14,000 volt flyback and a 17" rectangular gold trimmed plexiglas mask and safety shield. Suggested diagram furnished. Shipping weight, 50 lbs. via Express or Truck only. Stock No. 17-4XL. 17" conversion kit. Sale price, **$25.95**. Kit Price with GE or Raytheon 1 year guarantee picture tube, **$5.00** extra.

SPEAKER AND BAFFLE SALE

8" SPEAKER AND BAFFLE $4.95

Stock No. 818, Tan leatherette covered, plywood slant type wall baffle; plus an 8" Oxford, 2.15 oz. Alnico 3 magnet PM speaker. A red hot McGee special for only **$4.95** each, or **$4.70** each in lots of 3 or more.

10" SPEAKER AND BAFFLE $6.95

Stock No. CA-10, Tan leatherette covered plywood slant type wall baffle; plus a 10" Permaflux, 3.16 oz. Alnico V PM speaker. Only a few hundred to sell at **$6.50** each, or **$6.25** each in lots of 3 or more.

12" SPEAKER AIID BAFFLE $7.95

Stock No. CA-12, Tan leatherette covered plywood slant type wall baffle; plus a 12" Quam, 4.64 oz. Alnico V magnet PM speaker. (Popular Adjustacone model.) A terrific McGee value for only **$7.95** each, or **$7.50** each in lots of 3 or more.

RCA 201E1 T.V. TUNER $7.95

Terrific buy on this RCA tuner. We have a limited quantity of the famous original 201E1, 13 channel completely wired and tested TV front end tuners. Ready to connect to your TV video I.F. strip. Offered at a sacrifice. Price was $44.00. Now only **$7.95** each, with tubes. Each tuner in good condition but has been repaired. Stock No. RCA-13P, TV front end tuner. Convertor coil type for separate sound as used in the famous 630 chassis. Complete with 3—6J6 tubes, **$7.95**. Specify shaft length desired, either 2" or 4".

RCA 201E-1 T.V. TUNER

Same as pictured above only new—with 2⅛" shaft. Stock No. 2201. Sale Price, **$11.95**.

3-TUBE SARKES-TARZIAN T.V. TUNER $9.95

This popular Sarkes-Tarzian Type 3 tuner is widely used. 13 channel rotary type switch with individually tuned coils. Price is complete with diagram and three tubes: 6C4 osc., 6BH6 R.F. and 6AG5 mixer. Regular factory cost is twice our price. Each tuner is wired ready to hook up to a video and sound IF strip. May be used with either inter-carrier or separate sound IF circuits. Has built-in convertor coil, built in fine frequency control. Sarkes-Tarzian TV tuner, with 3 tubes. Net price, **$9.95** each. Specify shaft length, either 2⅛" or 4¾".

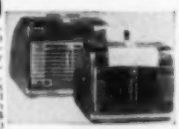
STANDARD COIL SUPER CASCODE TUNER $19.95

UHF STRIPS $9.40 EXTRA

The Cascode Circuit of the Standard Tuner offers a new development of this famous TV front end assembly which affords a 2-to-1 improvement in gain and a 35% to 50% reduction of noise over the pentode tuner. Other advances include: easy conversion to UHF reception by interchange of channel inductors; increased sensitivity for TV sets in fringe areas; elimination of booster use; and a high profit item for the serviceman as a replacement unit sale. Brand new factory TV-2000 TV tuner, compl. with tubes 6BK7 or 6BQ7 and a 6J6. Shaft length 3½". Scoop UHF (specify channel) strips supplied in pairs for above cascode tuner, **$9.40** per set. UHF strips for other models of the Standard Coil tuners specify channel and series; either F, G, K, Q, R, H or M as printed on the tuner, **$9.40** per set.

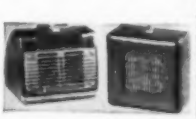
3 STATION INTERCOM MASTER $16.95

SUB STATION $3.95



3-station intercom master housed in chrome plated metal cabinet 7½"x6"x5" sloping front. Full 4-tube amplifier for 110 volt AC-DC operation. Press-to-talk switch is on top of the cabinet and volume control with off-on switch and station selector switch are on either side. May be used with from one to 3 sub-stations. (See matching cabinet chrome plated sub-station No. PM-A5). Master is quiet at all times except when press-to-talk switch is pressed at the master or call-back switch is pressed at the sub. Uses 3-wire intercom cable. 3-station intercom master MPM-A3, shipping weight 10 lbs. Sale price, **$16.95** each. sub-stations extra. 3-wire plastic intercom cable, 100 ft. for **$5.95**, 500 ft. for **$8.95**.

INTERCOM SUB STATIONS $3.95



Chrome plated, with call back switch for a 3-wire intercom master. Size 7½"x6"x5" sloping front. 5" Alnico V PM spkr. Intercom dealers buy at less than present production costs. Limited quantity. Stock No. PM-A5, ship. weight 8 lbs. Sale price, **$3.95** each or 3 for **$10.00**. Special 3-wire plastic intercom cable, 100 ft. for **$5.95**, 500 ft. for **$8.95**.

brown leatherette covered intercom sub-station with call back switch for use with 3-wire intercom masters. 5" square and 2½" deep. Has new plastic grill cloth. Alnico V PM speaker. A true McGee value. Stock No. NE-5, ship. weight, 1½ lbs. Sale price **$3.95** each or 3 for **$10.00**. 3-wire plastic intercom cable, 100 ft. for **$5.95**, 500 ft. for **$8.95**.

CAPEHART CABINET FOR 1000 SET—ONLY $99.95

BEAUTIFUL WALNUT

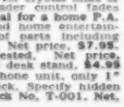
Beautiful, finest quality walnut combination radio-phono cabinet, 42" high, 42" wide and 22" deep. Made for Capehart's finest combination, selling for $1000 and up. Cabinet cost manufacturer, $200.00. Has highly polished matched walnut panels. Made of ¾ material. Top 1½ solid stock. This cabinet weighs approximately 175 lbs. The changer radio and speaker grill all have hinged doors. Radio compartment on right hand side is 14" high and 11½" wide. Made to mount chassis vertically. Changer compartment is 14" high by 20½" wide. Large enough to hold any record changer or recorder mechanism. Front 10" of top over the changer compartment is hinged to fold back for easy access to the changer. Both radio and changer compartments come with uncut blank panels. Speaker baffle is cut for a 12" speaker and the speaker compartment is completely enclosed. Shipping weight, 275 lbs. Stock No. K-275W Capehart combination cabinet. Net price, **$99.95**. Walnut.

COMPLETE RADIO, TELEVISION AND AMPLIFIER KITS AT McGEE

3-WAY PORTABLE KIT $15.95

New 1952 Model 3-way personal portable radio kit. Operates on 110 Volts AC-DC or 67½ B plus 1½ volt self-contained batteries. Leatherette covered case size, 5½x5¾x8". Receives broadcast 550 to 1650 KC. A conventional 2-gang superhet circuit with 456 KC iron core IF's. Incorporates the new super gain stick loop antenna. All plated chassis. Lab. approved circuit—matched parts. Price includes all parts, tubes, diagram, Alnico V PM speaker. A factory quality kit. Stock No. PN-47, shipping weight 7 lbs. The complete kit. Less batteries, **$15.95**. 67½V. B, **$1.99**; 1½V. A, **39c** extra.

Build Your Own Phono-Mike Broadcaster $7.95

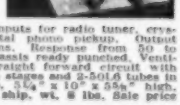


Kit Model DE-6R. With this simple kit, you can build a 3-tube phone oscillator that also has a mike input. Will broadcast over any radio within your home, about 75 feet from 1000 to 1500 kc. Inputs for crystal mike or crystal phono pickup. Fader control fades from mike to record. Ideal for a home P.A. system, baby listener and home entertainment. A complete kit of parts including tubes, Kit Model DE-6R, Net price, **$7.95**. DE-6RWT, wired and tested. Net price, **$9.95**. Crystal mike and desk stand, **$4.95 extra**. Concealed microphone unit, only 1" in diameter and ¼" thick. Specify hidden mike when ordering. Stock No. T-001. Net, **$3.95 extra**.

8-Tube Hi-Fi Amplifier Kit $29.95

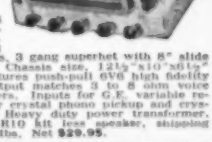
A complete kit including tubes: 3-7E5, 2-12AX7, 2-triple plus rectifier diagram and photos. Inputs for radio tuner and any kind of phono pickup (crystal or G.E. variable reluctance) and either crystal or dynamic mike. Output matches 8 ohm voice coil. Twin electronic bass and treble tone controls with range selector switch for either juke box quality with heavy bass response or brilliant symphonic range. Response 18 to 20,000 cps. 8 tube all triode amplifier kit, complete with tubes. Shipping weight 25 lbs. Model 7X5. Net **$29.95**.

10-Watt Hi-Fi Amplifier Kit $14.95



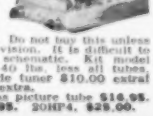
A complete kit of parts including tubes, 2-6L6, 12AX7, 12AU7, 2-5Y3G, plus rectifier, diagram and instructions to build a hi-fi fidelity twin tone control audio amplifier with bass and treble boost. Inputs for radio tuner, crystal mike and crystal phono pickup. Output matches 8 ohms. Response from 50 to 15,000 cps. Chassis ready punched. Ventilated cover. Straight forward circuit with twin triode gain stages and 2-5U4 tubes in push-pull. Size, 5¼" x 10" x 5¾" high. Model AP-10R, ship. wt. 8 lbs. Sale price **$14.95**.

10-TUBE RADIO KIT $29.95



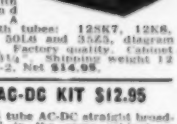
10 tube broadcast radio chassis kit, complete with tubes: 2-6SK7, 6SA7, 3-6SN7, 1-6SL7, 2-6V6 plus 5Y3 rectifier, diagram and instructions, 3 gang superhet with 8" slide rule dial. Chassis size, 12½"x10"x5½" high. Features push-pull 6V6 high fidelity audio. Output matches 3 to 8 ohm voice coil speakers. Inputs for G.E. variable reluctance or crystal phono pickup and crystal mike. Heavy duty power transformer. Model HK-R10 kit less speaker, shipping weight 18 lbs. Net **$29.95**.

17, 20" T.V. Kit $59.95 Less Tubes



A complete kit of parts to build an AC transformer operated television chassis for use with a 16", 17" or 20" rectangular picture tube. It is designed for Sarkes-Tarzian tuner is ready wired, as is the tube video IF strip. Circuit is of the conventional design. Do not buy this unless you understand Television. It is difficult to wire. We furnish schematic. Kit model WH-20. Ship. wt. 40 lbs. less all tubes. Net **$59.95**. Cascode tuner $10.00 extra! 12" speaker $2.95 extra. Kit of 24 tubes, less picture tube **$16.95**. 17" 17BP4A, **$19.95**. 20HP4, **$29.00**.

6-TUBE 2-BAND KIT $14.95



Popular with schools and colleges for training. 6 tube AC-DC, 2 band radio kit with plastic cabinet. Receives broadcast and 6 to 18 meg. shortwave. Full 2 gang superhet with 5" speaker and slide rule dial. A complete kit with tubes: 12SK7, 12K8, 12SK7, 12SQ7, 50L6 and 35Z5, diagram and instructions. Factory quality. Cabinet size 13"x8¾"x8¼". Shipping weight 12 lbs. Model ME6-2. Net **$14.95**.

5-TUBE AC-DC KIT $12.95

Model RS-5. A 5 tube AC-DC straight broadcast kit, housed in the same cabinet as ME6-2 above. Complete with tubes. Shipping weight 10 lbs., Net **$12.95**.

AC POWERED BROADCAST TUNER KIT $12.95

A self-powered, 3-gang superhet tuner kit with R.F. stage. This complete kit is furnished with a diagram, photos and tubes. 6BA6 R.F., 6ME6 oscillator R.F., 6BA6 I.F. detector, 6AL5 diode AVC, plus rectifier. Connect to any audio amplifier. Ideal for use with our 5-2020 or 7x5 amplifier kits. Chassis size, 9½x4x4½" high. Shipping weight, 7 lbs. Broadcast tuner kit Model BT-38X. Net price, **$12.95**.

McGEE RADIO COMPANY Prices F.O.B. K.C. Send 25% Deposit with Order. Balance Sent C.O.D. With Parcel Post Orders, Include Postage.

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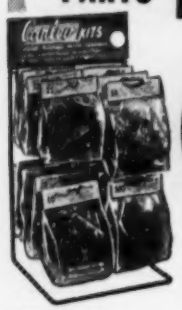

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All assortments are carefully selected to include the most popularly used sizes by **Servicemen, Amateurs, Laboratories, Dealers, Experimenters, Hams, Engineers** . . . and as replacements in all Electronic Equipment, including recent and current models.

Carlco RESISTOR KIT . . . No. RK-100 . . . Contains **100 Resistors,** brand new, standard brands, guaranteed perfect. 35 different ohmages (minimum), 1 ohm to 20 megohms. **Assortment:** 10 two watt; 20 one watt; 70 one-half watt.

Carlco CERAMIC CAPACITOR KIT . . . No. CK-35 . . . Contains **35 Ceramic Condensers,** brand new, standard brands, guaranteed perfect, 15 different capacities (minimum). Complete ceramic capacitor detachable **Color Code Chart** included on every package.

Carlco MICA KIT . . . No. MK-50 . . . Contains **50 Mica Condensers,** brand new, standard brands, guaranteed perfect. 10 different capacities (minimum) 5 MMF. to 1000 MMF. Each condenser **STAMPED** with easily read value in MMF.

Carlco MOLDED TUBULAR CAPACITOR KIT . . . No. TK-25 . . . Contains **25 Molded Tubular Condensers,** brand new, standard brands, guaranteed perfect. 400 and 600 volts, 12 different capacities (minimum) up to 1 MFD. Complete molded tubular condenser detachable **Color Code Chart** included on every package.

Carlco LOW VOLTAGE ELECTROLYTIC KIT . . . No. LV-10 . . . Contains **10 assorted** brand new, standard brands, guaranteed perfect, **Low Voltage Electrolytics** including **FP's.** Each condenser clearly stamped with value. Voltages up to 50 v.

JOBBERS—our GUARANTEED SALES PLAN assures you that if, for any reason, you find our items do not move as fast as you would like, we will accept return of unsold portion for full credit —**NO QUESTIONS ASKED!**

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MANUFACTURERS' LITERATURE

Readers are asked to write directly to the manufacturer for the literature. By mentioning RADIO & TELEVISION NEWS, the issue and page, and enclosing the proper amount, when indicated, delay will be prevented.

HI-FI CATALOGUE

Mark Simpson Mfg. Co., 32-28 49th Street, Long Island City 3, N. Y. has available for distribution a new catalogue describing its "Concert Master" high fidelity amplifier with remote preamplifier, the Model CMR-20.

This four-page catalogue contains full technical specifications and highlights as well as photographs of the unit itself.

When writing for copies of this publication, please specify catalogue #CM-53.

U.H.F. EQUIPMENT

General Radio Company, 275 Massachusetts Avenue, Cambridge 39, Massachusetts has recently issued a six-page bulletin covering its line of u.h.f. measuring equipment and accessories.

Illustrated and described are such units as coaxial elements, attenuators, modulators, mixer rectifiers, voltmeter rectifiers and indicators, baluns, constant-impedance adjustable lines, component mounts, insertion units, adapters, the company's standard signal generator, a bolometer bridge, a heterodyne frequency meter, and a unit u.h.f. oscillator.

A copy of this data sheet is available on request.

MIKE MIXER DATA

A new electronic microphone mixer and preamp, the *Masco* Model EMM-6, is described in a catalogue sheet currently available from *Mark Simpson Mfg. Co., Inc.,* 32-28 49th Street, Long Island City 3, N. Y.

The new unit is designed for electronically mixing the outputs of up to four microphones and two phonographs or radio tuners into any amplifier, p.a. system, tape, disc or wire recorder, or broadcast input channel.

The catalogue sheet provides full specifications and is available on request.

CABINET CATALOGUE

G & H Wood Products Co., 75 North 11th St., Brooklyn 11, N. Y. has issued a revised catalogue on its "Cabinart" line of custom-styled high-fidelity cabinets and kits.

Fully illustrated, the new catalogue is a complete resumé of cabinet design information. Each unit is illustrated to give a good idea of its period and styling. Individual specifications and spot illustrations highlight each cabinet's layout and equipment requirements.

Copies of this compact catalogue are available from local parts distributors or from the company direct.

TOWER BROCHURE

Rohn Manufacturing Co., 116 Limestone, Bellevue, Peoria, Illinois has announced the availability of a two-color brochure covering its entire line.

The publication lists three types of self-supporting steel towers, the fold-over tower kit, telescoping masts, and new TV service table. In addition, it lists, illustrates, and fully describes the company's full line of TV and tower accessories. Catalogue numbers are given for easy ordering.

Dealers may obtain copies from their representatives or distributors or by writing the company direct.

MUSIC SYSTEMS DATA

Audak Company, 500 Fifth Avenue, New York 36, New York has announced the availability of a 1953 edition of its popular booklet "Electronic Phono Facts" by Maximilian Weil.

This 20-page, pocket-sized publication contains the answers to more than 100 important questions relating to audio-electronic music systems. Stripped of all technical verbiage, the answers are given in layman's English.

Copies of this booklet are priced at $1.00 each and may be obtained either from *Audax* dealers or from the company direct.

KAAR CATALOGUE

Kaar Engineering Corp., Middlefield Road, Palo Alto, California has just issued a comprehensive "summary" catalogue covering its line of mobile equipment.

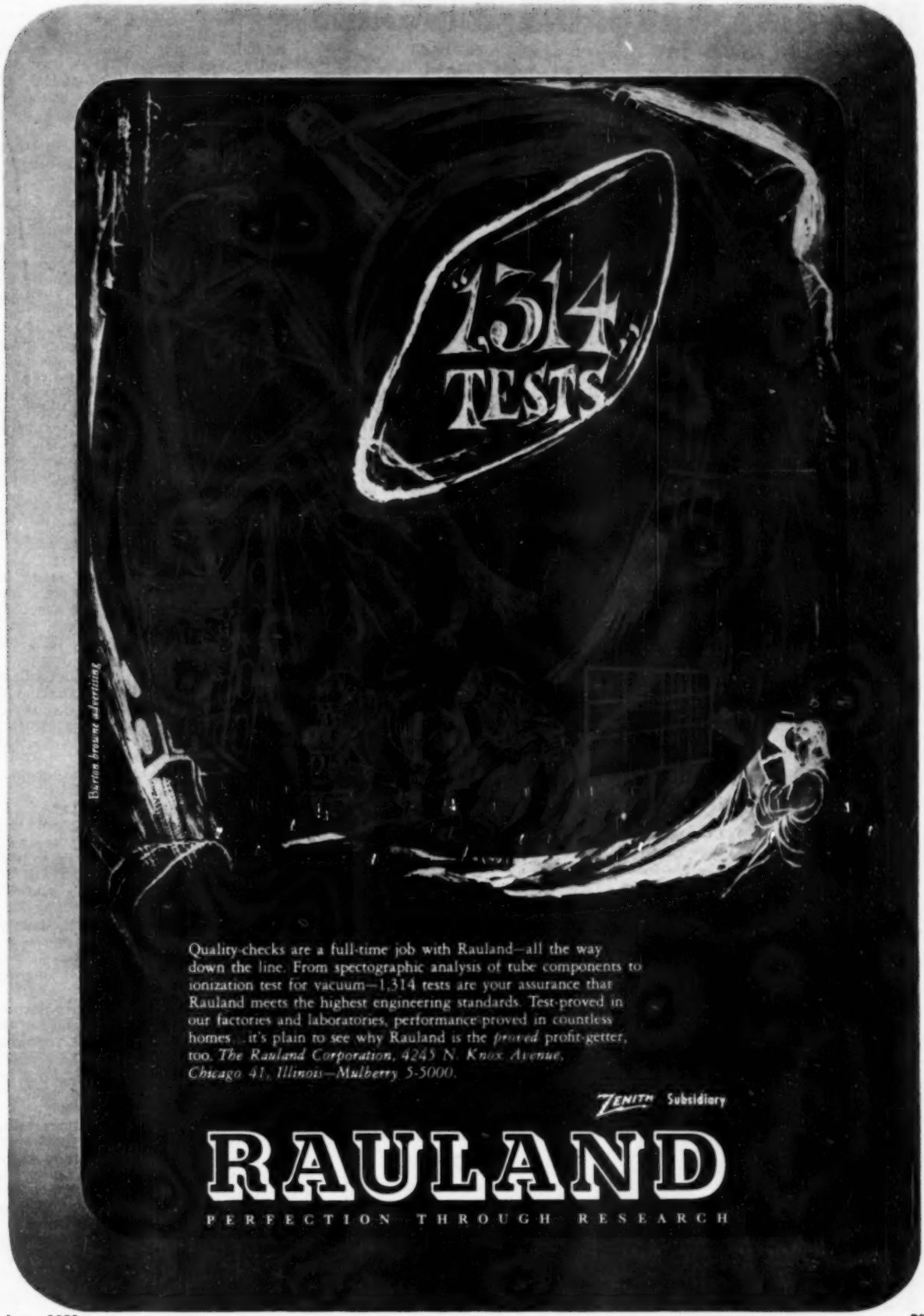
All mobile radiotelephone units manufactured by the company are included with the information being presented in capsule form to provide quick reference with a minimum of effort.

The company's line includes mobile and station equipment for use in the 152-174 mc. band, the 25-50 mc. band, and the 1600-6000 kc. band. In addition, the complete line of the company's accessories is included.

Copies are available without charge from the manufacturer.

NEDA BATTERY INDEX

The second edition of the "NEDA Battery Index" is currently available from the National Electronic Distributors Assn., 228 N. LaSalle Street, Suite 1114, Chicago 1, Ill.



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6BC5	.58	12BA6	.47
6BC7	.86	12BE6	.47
6BE6	.48	12SA7	.52
6BQ6	1.21	12SK7	.49
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6BK7	.86	12SQ7	.42
6BQ5	.76	14AF7	.59
6BQ7	.86	19T8	.78
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6C06	1.79	25W4	.48
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Details on how copies of this new index may be obtained will be supplied by NEDA on request.

MAGNETIC TAPE BOOKLET

A new four-color, 16-page illustrated booklet entitled "A New Horizon in High Fidelity Recording" has been issued by *Minnesota Mining and Manufacturing Co.*, 900 Fauquier St., St. Paul, Minn.

The booklet tells the story of "Scotch" brand "High Output" magnetic tape No. 120 recently introduced by the manufacturer. Included are the major advantages of the tape, an explanation of the significance of these advantages in terms of the recording and broadcast engineer as well as the hi-fi enthusiast, and bias requirements and frequency response characteristics in graph form.

The booklet is available on request. Write direct to the company.

ELECTRON TUBE NOTES

A summary of data-sheet rating interpretations and a series of notes concerning means of improving electron-tube service life are included in a new leaflet, Form 153, covering "Los Gatos" brand electron tubes.

The publication also includes a field-engineering location map and list of the company's field-engineering representatives.

Copies of Form 153 are available from *Lewis and Kaufman, Ltd.*, 76 El Rancho Ave., Los Gatos, California.

RCA SERVICE BOOKLET

The Tube Department of *Radio Corporation of America* has prepared a 33-page booklet which outlines ways of achieving greater profits and increased efficiency in radio and TV service operations.

The booklet also includes descriptions of business practices and essential test equipment used by successful service organizations throughout the industry.

Sections of the booklet are devoted to illustrations and descriptions of the company's test equipment designed specifically for use in radio and TV servicing. Complete specifications are given along with hints on applying the equipment most effectively.

The business-guide sections cover such important management subjects as budget planning, wage and salary considerations, materials, stock control, employee training, customer relations, and methods for reducing operating expenses and costs.

Entitled "This Business of Radio and TV Servicing," the new booklet is now available from *RCA* tube, parts, and test equipment distributors. —30—

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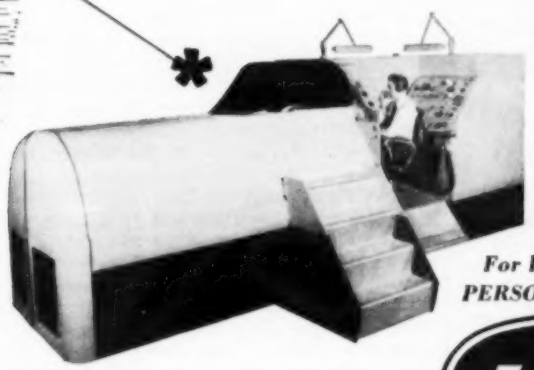

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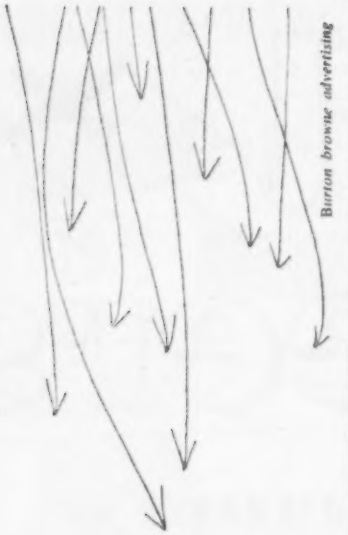

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Probe Switch

(*Continued from page 72*)

tube at the point this nut will rest when in place. Then, holding the rotary contact one-half way between the limits of its rotation, insert it into the tube midway between the stator contacts. When the adhesive sets, the switch is finished.

From the experience gained building the original switch, here are some pointers. Select a heavily knurled nut for the part, Fig. 2C, because the ridges formed by the knurling help to hold the adhesive, and the slightly enlarged diameter of a heavy knurl gives a good fit against the tube wall, while allowing the necessary clearance to the smooth section of the following nut. The enlarged diameter of the knurling mentioned is indicated by the heavy outlines in the drawings, as noted in Fig. 2C.

The diameters of the stator support bar, Fig. 2D, apparently difficult to produce without a lathe, are easily made on a drill press. This part was made by putting a ⅜ in. o.d. Bakelite rod into the drill and running it at about 750 rpm. Then, using a flat file, the two diameters were brought to size. The shoulder on the nut, Fig. 2C, was made by the same process. With a little patience these jobs can be done on a hand drill clamped in a vise.

It is not necessary to follow the dimensions given in Fig. 2. Use them only as a guide. The important thing is to dimension the parts so that the rotor contact will slip smoothly into place with the type of stator contacts used. These dimensions may vary with the make of switch from which the stator contacts are taken.

A study of Fig. 2B will make the switch operation clear. Setting the switch to either position is accomplished by a half turn on the nut *H;* clockwise for a.c. voltage and resistance measurements, and counter-clockwise to place the resistor in the circuit for d.c. voltage readings. As the electrical contact is made, a frictional switch lock is also applied by the phone tip threads. As drawn, the pressure for this locking action is applied between the shoulder *J* of the phone tip *A,* and the contacting surface of the nut *C.* Turning the nut, *H,* clockwise will release the pressure by moving the shoulder away from the nut, and as the opposite electrical contact is made, the locking action pressure will take place between the meeting surfaces of the nuts, now shown separated by one-half the pitch of the phone tip threads. *Caution,* do not turn the switch too hard, for the fine pitch of the phone tip threads will multiply the applied pressure the same as a lever. Only light pressure is required to lock the switch. Heavy pressure may only make it hard to operate.

Considering the fact that the direction of the applied turning movement on the nut *H* will indicate the function for which the switch is set and that the switch stops will indicate the full engagement of the contacts, practically automatic operation is obtained.

Electronically, a slight increase in the stray capacity of the probe, due to the stator contact assembly, can not be avoided. However, by holding the probe above the engraved white line, indicated in Fig. 2E, to avoid any body capacity when measuring sensitive circuits, the effect of the additional probe capacity will not be noticeable. –30–

1953 Philco TV Sets

(*Continued from page 61*)

Video i.f. alignment:

1. Preset the contrast and brightness controls to the maximum counterclockwise position.

2. Preset the channel selector to Channel 4.

3. Connect an oscilloscope to the video detector test point on J_{205} (see Fig. 14) through a 15,000-ohm resistor.

4. Connect the negative side of a 6-volt battery to the a.g.c. test point on J_{205}. Connect the positive side to ground.

5. Connect the AM generator to the mixer grid test point, G_1.

6. Refer to Fig. 14. Adjust the various trimmers shown on this diagram of the r.f. chassis in the order given and for the response indicated, changing the frequency of the AM signal generator for each trimmer adjustment.

7. Connect a sweep generator and r.f. marker generator to the antenna terminals through a 72-ohm to 300-ohm matching jig. Connect a 7.5-volt battery to the a.g.c. test jack, with the negative terminal to the bias lead and the positive terminal to the ground lead. Set the channel selector to Channel 4, and tune the sweep generator for output on Channel 4. Tune the r.f. marker generator for the video carrier frequency of Channel 4 (67.25 mc.) and tune the i.f. marker generator (connected to mixer grid) to 45.75 mc. Note that two marker generators are used for this procedure. The r.f. marker generator is connected to the antenna terminals, while the i.f. marker generator is connected to the mixer-grid test point, G_1.

8. A jig constructed from a piece of fiber tubing, with 3/16-inch inside diameter, and a brass machine screw which fits tightly into the tubing, is used to connect the generator to the test point. The screw is adjusted so that it clears the test point by approximately 1/64 inch. The output cable of the marker generator is connected to the head of the brass screw in the jig and to the chassis near the mixer tube. Both marker generators should be adjusted for the minimum output required to make the markers barely visible. Failure to observe this precaution, or the use of excessive output from the sweep generator, will cause misleading results. After the equip-

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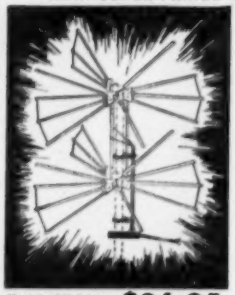

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ment is properly connected, adjust the fine tuning control for zero beat of the two markers, as observed on the oscilloscope. When zero beat is obtained, remove the i.f. marker.

9. If the response curve does not fall within the proper limits, the adjustment of the trimmers may be touched up slightly. Do not touch the setting of C_{310}, C_{201}, C_{202}, or C_{206}. To change the curve, first adjust C_{215} and C_{218} alternately, until maximum improvement has been obtained. Trimmer C_{218} affects the tilt of the curve, and C_{215} affects the dip of the curve. After C_{215} and C_{218} have been adjusted, turn C_{214} for the proper slope at the 42.25-mc. side of the curve, then adjust C_{204} and C_{210} for the proper level at the video carrier frequency (47.75 mc.).

CAUTION: Do not turn any of the trimmers excessively. To retouch, make only a slight adjustment. —30—

Master Audio Control

(*Continued from page* 63)

Distortion. *Harmonic:* 0.02% at 1 volt, 0.05% at 5 volts, 0.15% at 10 volts, 0.4% at 15 volts.

Intermodulation: 0.08% at 1 volt, 0.2% at 5 volts, 0.5% at 10 volts, 1.6% at 15 volts.

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Phono Input: 68 db below output with a 10 mv. input signal.

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From Low Level Input: in excess of 53 db.

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ALUMNI ORGANIZE

THE Alumni Association of RCA Institutes has been formed recently in New York with monthly meetings scheduled for the 3rd Thursday of each month at the school building, 350 West 4th St., New York City.

Officers include P. Genduso, president; T. R. Comiskey, recording secretary; S. Schiffman, corresponding secretary; J. Troop, treasurer; and P. Stein, faculty advisor.

—30—

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Growing civilian markets include radio-equipped police cars, fire-equipment, taxis, planes, ships—in increasing numbers. There are industrial radio network installations, medical applications, and countless others.

There are 152 TV stations now on the air, and 2000 more expected. Already it is estimated there are over 23,000,000 TV sets and over 100,000,000 radios in operation. How these figures will increase in the next few years, the most daring experts are reluctant to predict. This much is certain: Limitless numbers of positions must be filled—in development, research, design, production, testing, inspection, manufacture, broadcasting, telecasting, and servicing. To fill these posts, trained men are needed—men who somewhere along the line are alert enough to improve their knowledge and skills. "Your Future in the New World of Electronics" shows how CREI Home Study leads to greater earnings, by helping get you ready for the openings described above.

CREI promises no short cuts. In an accredited technical school such as this, *you must study* to transform your ambition and energy into knowledge that pays off. Since its founding in 1927, CREI has provided thousands of professional radio men with technical educations. During World War II CREI trained thousands more for the Armed Services. Leading firms choose CREI courses for group training in electronics at company expense; among them are United Air Lines, Canadian Broadcasting Corporation, Trans Canada Airlines, Bendix Products Division, All American Cables and Radio, Inc., RCA Victor Division, Mochlett Laboratories, Canadian Marconi and Heppner Mfg. CREI's practical courses are prepared by recognized experts. You get up-to-date material; your work is under the personal supervision of a CREI staff instructor, who knows and teaches you what industry needs. Training is accomplished on your own time, during hours chosen by you. As a graduate, you'll find your CREI diploma the key to success in Radio, TV and Electronics. At your service is the CREI Placement Bureau, which finds positions for advanced students and graduates. Although CREI does not guarantee jobs, requests for personnel far exceed current supply. CREI alumni hold top positions in America's leading firms. Now is the time to decide—to act. When opportunity knocks, knowledge must be "at home." You supply the willingness to learn. We supply the technical training. This combination of ambition and knowledge is unbeatable in the new Age of Electronics. Fill out the coupon and mail it now. We'll promptly send you your free copy of "Your Future in the New World of Electronics."

CREI resident instruction (day or night) is offered in Washington, D. C. New classes start once a month. VETERANS: If you were discharged after June 27, 1950—let the new G.I. Bill of Rights help you obtain CREI resident instruction. Check the coupon for full information.

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CAPITOL RADIO ENGINEERING INSTITUTE

Dept. 116, 3224 16th St., N.W., Washington 10, D. C.

Send booklet "Your Future in the New World of Electronics" and course outline.

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The Best in Electronic Surplus!

BARGAINS FOR HAMS, EXPERIMENTERS, INDUSTRIALS, AND EXPORTERS!

Most of the items listed below were illustrated and described in our February and April '53 ads of Radio & Television News. If you see anything you need more information on, don't hesitate to write us—we'll be more than glad to try and oblige.

SPECIAL! MOBILE TRANSMITTER, 5 Watts output, present range 2500 to 7700 KC using 4 plug-in tuning units which can be easily modified for higher frequency operation. Excellent VFO puts you right on frequency, or convert to crystal control. Uses 2 type 10 and 2 type 45 (mod.) tubes. Dimens. 11"x 6½"x6". Supplied with tubes (not guaranteed), tuning units, connectors, less dynamotor (operates from 12 or 24 V. DC, rewire tube filaments for 6 V. operation). Part of SCR-283 equipment. Excellent condition. Shpg. wt. 20 lbs. **EACH** **$9.95**

MOBILE or MARINE RECEIVER, full superheterodyne covering 200 to 400 KC and 4,150 to 7,700 KC with 2 plug-in tuning units. With 6 tubes (not guaranteed), 4 type 99, 1 type 37, and 1 type 38. Excellent condition with remote tuning dial and cable, connector cable, and shock mounting. Use with 12 or 24 V. Dynamotor (below listed) or 6 V. Vibrator pack—after rewiring tube filaments in parallel. Part of SCR-283. Dim. 13"x6¼"x8". Shpg. wt. 20 lbs. **PRICE, EACH** **$9.95**

DYNAMOTOR, for either or both above. 24/28 V. DC Input, 375 Volts at 150 ma. output. Excellent Condition. **EACH** **$3.95**

RADIOSONDE TRANSMITTER, AN/AMQ-14 to D. NEW, with temperature, humidity, and pressure instruments incorporated. **EACH** **$9.95**

2-STAGE AUDIO AMPLIFIER, WITH 60 & 150 CYCLE FILTERS. See April '53 ad in Radio & Television News for complete specs. NEW equip. With diagram. Shock mounted. With 6C8G tube. Shpg. wt. 5 lbs. **PRICE, EACH** **$6.95**

50-60 WATT WE SPEAKER UNIT. For horn or baffleboard mtg. Shock and blast-proof diaphragm. Response to 7,000 cps. 13 ohms imped. Dim. 6"x6"x 4½" deep. Throat opening 1¼" dia. New units, with 8 lb. Alnico 5 magnet. Shpg. wt. 15 lbs. **PRICE, EACH** **$18.75**

ROTARY CONVERTER, 32 V. DC to 110 V. AC. Mfd. by Kato. Sheet mounted, with in and out filtering. Conservatively rated 225 watts, good for 300 watts. Shpg. wt. 60 lbs. **PRICE, EACH** **$39.95**

AUDIO OSCILLATOR, 3 tones, for servicing, test or code practice. See Feb. '53 Radio News ad. NEW, with 12A6 tube. With diagram. Shpg. wt. 5 lbs. **PRICE, EACH** **$5.95**

GE VOLTAGE REGULATOR & POWER SUPPLY, uses 8 tubes (not supplied) to supply regulated 750 V. DC at 10 ma. or less from voltage divider. Has switch for "regulating" or "non-regulated" output. Operates from 110 V., 60 cy., AC. With diagram and operational data. NEW units. Shpg. wt. 25 lbs. **EACH** **$15.95**

BC-604 NB FM TRANSMITTERS, 20-28 MC, 35 Watts plone output, 10 channels crystal-controlled. Swell for mobile. NEW units, with tubes, less dynamotor. Shpg. wt. 40 lbs. **EACH** **$39.95**

BC-684 NB FM TRANSMITTERS. Same as above, but 28 to 38 MC. **PRICE, EACH** **$49.50**

DM-35 DYNAMOTOR, 12 V. DC Input, for above Transmitters. Output 625 V. 225 ma. Like-New units. Shpg. wt. 10 lbs. **EACH** **$25.00**

LUMINOUS TAPE, glows in dark—after exposed to light. For cellar stairs, light switches, photographic dark-room applications, etc. 1/10 ft. x ½" wide, per package. Shpg. wt. 10 lbs. for **10 PACKAGES—$4.75**

ELEMENTS FOR DYNAMIC PHONES. Permaflux moving coil elements for dynamic phones, handy-talkies, or for home-made dynamic mikes. Each with matching output transformer. 2" dia., ¼" deep. **FOUR for $2.95**

SOUND-POWERED MIKE ELEMENTS, Shure Controlled Transducer type, for microphones, headphones. Medium Imped. 1¾" dia. ½" deep. **FOUR for $2.25**

MAGNETIC PHONE ELEMENTS, Avlometer all-aluminum encased. Diaphragm type, sturdily and trouble-free constructed. 2¼" dia. ¾" deep. **FOUR for $2.25**

HS-33 HEADPHONES, hi-impedance, with PL-54 plug and headband. Like-New condition. Shpg. wt. 2 lbs. **EACH** **$3.95**

HS-33 HEADPHONES, 600 ohms impedance, with PL-54 plug and Headband. Like-New condition. Shpg. wt. 2 lbs. **EACH** **$3.39**

TU-6B, 7B, and 8B TUNING UNITS. Ham's delight for conversion and valuable parts. NEW units. Shpg. wt. 10 lbs. **EACH** **$4.95**

WAVEMETER & FIELD STRENGTH METER, 20-40 MC, with calibration curve. Has 1B4 tube, requires only 1.5 V. battery. Incorporates 0-100 microampers (3") meter for sensitive detection. See also Feb. '53 ad in Radio News. NEW units. Shpg. wt. 8 lbs. **PRICE, EACH** **$14.95**

INFRA-RED SNOOPERSCOPE TUBES, British type requiring lens system for focusing. For labs, schools, and industrial work. With full technical data and diagrams. Shpg. wt. 3 lbs. for **SIX tubes for $15.00**

FRONT-END LENS ASSEMBLY for above. Bausch & Lomb. **EACH** **$10.00**

PLAIN, MOUNTED TYPE LENS ASSEMBLY, for front or rear. **EACH** **$7.95**

PYRANOL CAPACITORS, 50-50-50 MFD. delta connected, 50 V. AC, for industrial applications. NEW units. Shpg. wt. 35 lbs. **EACH** **$5.95**

WE BUY Communications and Test Equipment, such as ARC-1, ARC-3, ART-13, SC-312, 342, TDE, TCP, TDB, ET-8019, ET-8012, ET-8506 (Receiver), BC-221 or SCR-211 Freq. Meters, BC-610 Transmitters, LM Freq. Meters, ETC. Must be Excellent Condition, no modifications. Let us know what you have; we will answer promptly with our best offer.

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We have a large stock of Transmitters, Receivers, Walkie-Talkies, VHF Equipment, Ship & Shore Communications, FM Broadcast Stations, Radar, Accessories, etc. Write and tell us of your requirements. Descriptive literature and prices available upon request.

MINIMUM MAIL ORDER $5.00

Include remittance for shipping charges, otherwise orders will be sent Ry. Exp. transportation collect. All packages over 20 pounds sent Ry. Exp.
All Above Material Subject to Prior Sale. 25% Minimum Deposit with All C.O.D.'s. All Prices F.O.B. Our Address.

— TELEMARINE —

COMMUNICATIONS CO.

3040 W. 21st Street, Brooklyn 24, N. Y.

Phone: ES 2-4300

TIME COMPRESSOR

Developed by the University of Illinois, this new device has almost unlimited possibilities in diversified fields.

THE University of Illinois has developed and demonstrated a "time compressor" which speeds up words or music without changing tone or ease of understanding. An hour's program material can easily be compressed into 45 minutes' time.

Inventors of the new unit are Prof. Grant Fairbanks, director of the University's Speech Research Laboratory; Dean W. I. Everitt of the College of Engineering; and R. P. Jaeger, formerly at Illinois, now with a commercial laboratory.

The development is based on the fact that the ear is faster than the mouth. Words can be understood more rapidly than they can be spoken. Attempts to speed up speech causes the speaker to slur or trip over his words. The new invention overcomes this by recording speech in condensed form without changing the pitch, as happens when an ordinary recording is speeded up.

The machine incorporates a mechanism consisting of a continuous loop of recording tape and a set of four pickup heads in a revolving drum around which the tape makes a right-angle turn.

The pickups are arranged like the spokes of a wheel. Only one pickup touches the tape at a time, but just as it moves off, the next comes into contact with the tape. As far as the sound output is concerned, the playback is continuous, but actually that part of the original sound which was between the "spokes," and untouched by them, is left out.

The tape and drum run at different speeds and these can be varied independently to obtain any degree of compression desired.

Alternately, the drum can revolve the other way so that each pickup overlaps somewhat on sound the previous head covered. This repeats the bit of sound and thus the machine becomes a "time expander."

The output of the machine is recorded at a rate adjusted so that the result has the true pitch of the original.

The machine has another important potentiality. Instead of compressing time, it can be used to compress the tones of a voice, and then expand them back to original understandability. This is an almost instantaneous process which may permit a telephone or radio circuit to carry many conversations where one is now carried.

The problem of "bandwidth reduction" has interested engineers for a long time. They have found various ways of making circuits do multiple duty, and now the compressor may offer another possibility of carrying more messages without building additional transmission facilities.

The present "time compressor" is still a laboratory model in the University's Speech Research Laboratory, although it is the fourth model. Soon such machines will be available for radio stations and recording studios.

In addition to the more obvious applications for this device, it has already been suggested that the device be used for recording talking books for the blind to present the maximum material in the minimum amount of time; recording music for unbelievable rapidity and precision; for recording conferences, conversations, airport control directions, etc. on less tape so that they can be reviewed in less time; for a faster presentation of facts in broadcasts beamed to countries behind the Iron Curtain with less danger to listeners; faster reports over long distance telephone or radio; new production opportunities for motion pictures and television; new techniques for teaching; and new approaches to study of speech, music, and languages.

According to reports, compressions of 10 per-cent or even 20 per-cent pass unnoticed. Up to 50 per-cent does not destroy understanding of speech. Music put through the machine has its tempo stepped up, but pitch and clarity are unchanged. —30—

Prof. Fairbanks and Dean Everitt, two of the "time compressor" inventors, look over the laboratory model of unit at U. of Ill.

Valuable 3-way aid
for Auto Radio Repair
Men!
Once you're on the Delco Radio team you're in line for this three-way help: a reliable source for Delco Radio original equipment replacement parts and universal replacement parts; a complete and comprehensive Delco Radio Service Manual; monthly issues of "Testing Tips," a bulletin giving the very latest factory information on testing and repairing Delco car radios—even the sensational new "Favorite Station" Signal-Seeking model! To get going with Delco Radio contact your nearest United Motors Electronics Parts Distributor. Don't delay—act today!
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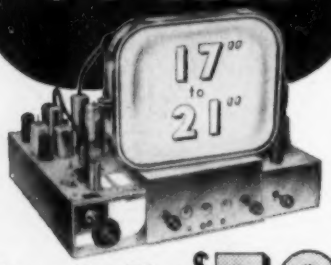
Let me show you how EASY it is to

LEARN TV

the practical way--

ASSEMBLE A TRANSVISION

TV KIT



Pay as You Wire $39 Down Payment

I WILL HELP YOU to start learning TV the *practical way* — by assembling a TRANSVISION TV KIT in EASY STAGES. For only $39 you get PACKAGE #1 (standard first pkg. for all of our kits). This package gives you the BASIC CHASSIS and over 450 TV COMPONENTS with *complete Instructions.* When ready, you order the *next* stage (pkg. #2), etc. All stages (or packages) are low priced, making your complete kit a terrific buy! Your completed chassis is a *superb 25 tube set* (22 tubes and 3 rectifier tubes) with 6"x9" p.m. speaker — a custom-chassis worth up to 100% above your investment.

EDUCATIONAL:

No previous technical knowledge required. With PACKAGE #1, you get my handy 70-page plastic-bound *Instruction Book* which includes a *20-page Service Section.* Also *12 full size (17"x22") Drawings and Photographs,* a 64 page *Service Booklet,* and 1 year's subscription to my *"TV and Electronics Notes".*

AIDS CAREER:

Do you plan to be a *TV Technician, Service-Dealer,* or *Engineer?* You'll benefit by assembling a Transvision TV Kit.

PROFIT 3 WAYS:

You profit by *gaining valuable practical knowledge . . .* by *saving on servicing costs . . .* and by producing a *TV chassis worth up to 100% above your cost.*

FEATURES

given only in new Transvision TV Kits:

No previous technical knowledge required . . . Easiest to assemble . . . **New A4 circuit gives finest picture and sound** . . . Ideal for fringe areas . . . Has Automatic Frequency Control . . . Automatic Gain Control . . . Retrace Elimination . . . **Never obsolete** because color and other developments can be added easily . . .

Choice of **6 Kits.**

UHF and **REMOTE CONTROL** may be had at small additional cost.

EXPORTERS: Foreign system of 625 lines can be accommodated.

For complete line of TV Cabinets, ask for folder.

Used in Naval Reserve Training Program.

FAMOUS EDITOR of a national science magazine says: *. . . my own assembly (of the kit) produced top-quality results,* comparable with any set I've seen and *better than most . . .*"

FREE CATALOG describes 6 great new Transvision TV Kits.

Write to D. GNESSIN, EDUCATIONAL DIRECTOR, at:

TRANSVISION, INC., Dept. RN6K **NEW ROCHELLE, N. Y.**

MAIL THIS COUPON TODAY

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☐ I'm enclosing $_____ deposit. Send standard kit PACKAGE #1, with all Instruction Material. I'll pay the balance C.O.D.

☐ Send FREE copy of your new TV Kit Catalog, Cabinet Folder, and Price Lists.

Name_____

Address_____

City_____ State_____

What's New in Radio

(Continued from page 78)

as part of the *Wharfedale* line of loudspeakers and associated equipment.

The new network is designed to be used with three-speaker sound systems. Its purpose is to properly divide and separate frequencies between the woofer, mid-range speaker, and tweeter. The three loudspeakers should be of similar sensitivity.

Crossover points are at 800 and 5000 cycles and the network is of constant resistance half-section construction. It is also fitted with a volume control across the high-end output terminals to suit upper frequencies to the listeners' individual tastes.

For literature and additional information on the crossover network write Dept. W of the company.

SELENIUM RECTIFIER KIT

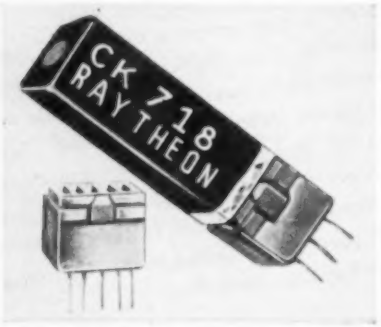
A new "build-your-own" selenium rectifier kit that enables the assembly of a wide range of selenium stacks at substantially reduced cost has been introduced by *Federal Telephone and Radio Corporation* of Clifton, N. J. for the electrical-radio-television market.

Designed to meet the rectifier requirements of a variety of users, ranging from radio hams and hobbyists to service technicians and electrical repairmen, the kit includes all the necessary components for assembling any one of four different types of selenium rectifiers—half-wave, full-wave center-tap, full-wave bridge-type, and full-wave battery charger.

Complete and simple step-by-step instructions are included with each kit.

TRANSISTOR SOCKET

Super Ear Products Co., 675 Merrick Road, Lynbrook, New York is



now offering a new subminiature socket for use with the new *Raytheon* transistors.

The three-prong socket measures approximately ¼" wide and ⅜" high and is molded of mica-filled Bakelite —a high-impact resistant material. The prongs are of phosphor bronze, silver-plated. The sockets are also available with the prongs pre-tinned for assembly-line applications.

L. Veltri, busy service-dealer of Westchester, N. Y., reports:

I SAVED $940*

by making a $59 INVESTMENT

in a Transvision

FIELD STRENGTH METER

*Says Mr. Veltri: ". . . The way I figure, in the last 6 months I saved that much money in installation time alone . . ."

FIELD STRENGTH METER

Saves 50% of Installation Cost

Pays for itself on 3 or 4 jobs

NO TV SET NEEDED

Works from antenna . . . Measures actual picture signal strength *directly from antenna.* Shows antenna orientation maxima. Compares gain of antenna systems. Measures *TVI* on all channels. Checks receiver re-radiation (local oscillator). *Permits one man antenna installation.*

Eliminate variables, insure accuracy with direct meter readings on the FSM.

PREVENT WASTE OF SERVICING TIME! By checking antenna performance with the *Field Strength Meter,* the serviceman can determine whether the *TV set* or *antenna,* or *both,* are the source of trouble. *Call backs are eliminated.*

Don't lug sets. The Transvision FSM makes installation easy.

Wide range: Measures field strength from 10-50,000 microvolts. Has *Fringe Area Switch* for weak signal areas. 13 channel selector. Individually calibrated on every channel.

ADAPTABLE for UHF

Model **FSM-2,** for *110V AC only.* Complete with tubes. Wt. 13 lbs. ..... **net $59.**

Model **FSM-3B,** for *110V AC and Battery Operation* (all batteries and cables included). Wt. 22 lbs. ..... **net $79.**

Order direct from factory:

TRANSVISION INC., NEW ROCHELLE, N. Y.

FREE: Sample copy of **"TV and Electronics Notes".** Or send 50¢ for year's subscription.

10 DAY TRIAL

Buy and try this fine instrument for 10 DAYS. Then, if you wish, you may return it. Your purchase price less 10% (our cost of handling and re-packaging) will be promptly refunded.

TRANSVISION, INC.
DEPT. RN-6F NEW ROCHELLE, N. Y.

( ) Send me_____Model FSM-2; _____FSM-3B

( ) Enclosed find $_____deposit. Balance C.O.D.

( ) Enclosed find $_____in full.

I accept your 10 Day Trial terms.

Name_____

Address_____

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BIG PROFITS:
Repair CRTs this Easy Way

EVERY SERVICE SHOP CAN MAKE BIG MONEY with these PATENTED INSTRUMENTS for

1. **TESTING** picture tubes accurately.
2. **REACTIVATING** dim or worn out tubes.
3. **SPARKING OUT** electrical leakage.

CRT TESTER—REACTIVATOR—SPARKER

3 Instruments in 1, making a complete CRT testing and repair unit . . . It's a combination of the Transvision **Tester-Reactivator** and a **Sparker** in one handy unit. It *TESTS picture tubes*—measures Cathode emission, locates shorts between elements, locates high resistance shorts or leakage as high as 3 megohms. *REACTIVATES dim tubes. SPARKS OUT* electrical leakage.

$34.95 net

Featured in N. Y. Times article

CRT TESTER—REACTIVATOR

2 Instruments in 1 . . . As a **REACTIVATOR** it renews brightness and detail of dim CR Tubes, without removal of tube from set. It's also an accurate **TESTER** same as the above. 110V-60 cycles; wt. 3 lbs.

only $19.95 net

CRT TESTER—SPARKER

2 Instruments in 1 . . . As a **SPARKER**, it sparks out electrical leakage between elements. *Saves many picture tubes and small tubes* which would usually be discarded. Cathode-grid leakage is an especially common occurrence. The *Sparker* also gives a rapid check of gas condition of the tube.

As a TESTER it provides a variable 8,000-14,000 V D.C. supply—useful for analyzing hard-to-solve deflection problems . . . **$25.95 net**

Order direct from factory:

TRANSVISION INC., NEW ROCHELLE, N. Y.

FREE: Sample copy of **"TV and Electronics Notes"**. Or send 50c for year's subscription.

SEAL OF APPROVAL

10 DAY TRIAL: *Buy and try these fine instruments for 10 DAYS. Then, if you wish, you may return them. Your purchase price less 10% (our cost of handling and re-packaging) will be promptly refunded.*

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DEPT. RN-6R NEW ROCHELLE, N. Y.

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( ) Enclosed find $_____ deposit. Balance C.O.D.

( ) Enclosed find $_____ in full.

I accept your 10 Day Trial terms.

Name _____

Address _____

City _____ State _____

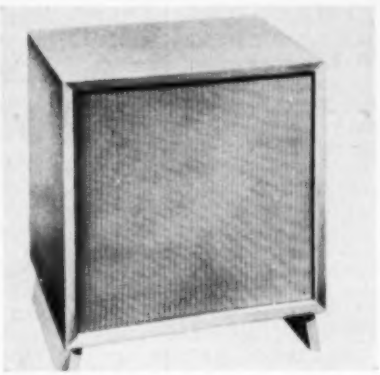
A five-prong socket for the *Raytheon* DX series of subminiature vacuum tubes is also available.

The company will supply full details on request.

R-J FLOOR MODEL ENCLOSURE

R-J Audio Products, Inc., 164 Duane Street, New York 13, New York has recently added a new smooth-sanded, unfinished mahogany floor model enclosure to its line.

The new model is made to the same



dimensions and will perform the same as the regular floor model enclosures the company is currently marketing. The enclosure is cut to fit any standard 12" or 15" speaker, permitting maximum bass performance.

Additional information on the new unfinished model or other units in the company's line is available from Dept. R-J of the company.

TURNER MIKE

The Turner Company of 900 17th St., N.E., Cedar Rapids, Iowa is in production on a new dynamic microphone, the ADA 95D.

The new unit follows the trend toward slender, modern styling yet provides rugged service for quality p.a., recording, and broadcast uses.

Frequency response is 70 to 10,000 cps with an output level of 58 db below one volt/dyne/sq. cm. A standard ⅝"-27 coupler swings the mike in a 60-degree arc. It is finished in satin chrome and comes equipped with a 20 foot removable cable set. A choice of 50,200,500 ohms or high impedance is available, as well as various switching arrangements.

TINY RESISTORS

Dale Products, Inc. of Columbus, Nebraska has placed a new deposited carbon resistor with silicone coating on the market.

According to the company, the tiny DCS ½ offers accuracy, stability, dependable performance, and economy in high frequency applications. The resistance range is from 5 ohms to 2 megohms.

New illustrated literature and price lists on the DCS ½ are available from the company on request.

—30—

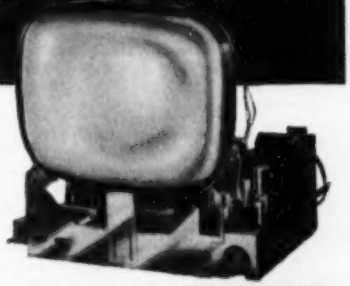
Now . . . INSURE BEST RECEPTION with the

FINEST TV CHASSIS EVER DESIGNED

TRANSVISION 630 *De Luxe* TYPE TV CHASSIS

with High-Fidelity Sound

Mfr. licensed under RCA patents



Embodies the latest and finest improvements, notably:

- **Super Fringe Area Circuit**
- **Redesigned for Peak UHF Performance**
- **Hi-Fidelity Push-Pull Audio (40-13,000 Cycles)**
- **12" Hi-Fidelity Speaker**

$139 net
Plus 10% Fed. Tax
CRT EXTRA

In this space we can mention only a few of the other great features of this DeLuxe Chassis: **31 tubes** (28 tubes, 3 rectifier tubes —plus CRT makes 32 tubes) . . . Only **Sprague "Black Beauty"** Molded Condensers used throughout . . . **Allen Bradley** and **IRC RESISTORS** . . . Handles **up to 24"** picture tube . . . Layout of most efficient type for ease of servicing . . . **Carries standard RMA Guarantee** . . . The choice of those who want the finest in chassis.

CABINETS: For details on Transvision's famous beautiful line of TV Cabinets, write for information on Agent's Program.

1 YEAR GUARANTEE ON CRTs

17" Rectangular Glass CRT.....net $22.25
20" Rectangular Glass CRT.....net $31.95
21" Rectangular Glass CRT.....net $36.95

Order direct from factory:

TRANSVISION INC., New Rochelle, N. Y.

FREE: Sample copy of "TV and Electronics Notes." Or send 50c for year's subscription.

MONEY-BACK GUARANTEE:

10-DAY TRIAL: Buy and try the Transvision 630 Type De Luxe Chassis for 10 days. Then, if you wish, you may return it. Your purchase price less 10% (our cost of handling and re-packing) will be promptly refunded.

Ask for **FREE** *Circuit and Technical Data*

TRANSVISION, INC.
DEPT. RN-630 NEW ROCHELLE, N. Y.

( ) Send me 630 Circuit and Technical Data.

( ) Enclosed find $_____ deposit. Balance C.O.D. Ship _____ chasses. _____ CRTs.

( ) Enclosed find $_____ in full.

I accept your 10 Day Trial terms.

Name _____

Address _____

City _____ State _____

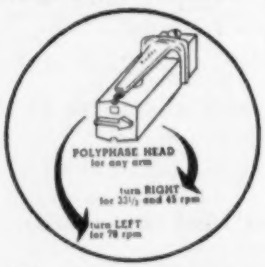
"In music, listening quality IS everything...

It is the No. 1 MUST. Without it everything else becomes meaningless. The AUDAX CHROMATIC has that quality to a degree not equalled by any other pickup" . . . *so says the violinist David Sarser, of amplifier fame (Toscanini's NBC Symphony).*

Be it diamond or sapphire, every stylus has a limited life-span; the diamond lasts the longest. Obviously, then, replaceability of the stylus—at home, is of the greatest importance. AUDAX is engineered for easy replaceability of the stylus—at home. **Of further importance is the fact that each AUDAX CHROMATIC stylus is replaceable *independently* of the other.**

The magnetic attraction between pick-up and a steel turntable is known as the "Hidden-Pull."* Today, with point-pressure under 10 grams, an additional 10 or 20 grams of "Hidden-Pull" becomes a very serious factor . . . The Magnetic Audax CHROMATIC has no "Hidden-Pull."

Only YOU can decide what sounds best to you. Therefore, See and Hear the Audax CHROMATIC and—You be the judge . . . Audax costs no more than ordinary pickups.



Available with the new Compass-Pivoted Audax arms and to fit the high quality record changers.

Only in Audax is each stylus replaceable independently of the other. Send for free facts on jewel styli.

** 4th in 1953 ELECTRONIC PHONO FACTS now obtainable from your dealer*

AUDAK COMPANY
500 Fifth Avenue, New York 36
Creators of Fine Audio-Electronic apparatus for over 25 years

"The Standard by Which Others Are Judged and Valued"

4-CHANNEL CONTINUOUS RECORDER-REPRODUCER

New communications network monitoring system makes possible a permanent and continuous record of radio or phone messages.

MAGNECORD, Inc. of Chicago has developed a unique four-channel, continuous recorder-reproducer system for the Civil Aeronautics Authority to CAA specifications for communications network monitoring.

The system consists of an enclosed, rack-mounted recorder, separate playback unit, portable test equipment for adjusting components, a movable table and storage unit, and a portable continuous bulk eraser. The recorder will operate continuously for eight hours without tape changing and uses standard ¼ inch recording tape.

Mounted in the rack are two tape transports, each independently removable while the other remains in operation. Each tape transport contains a four-track recording head assembly and a movable monitoring head which may be indexed to any of the four recording channels for monitoring purposes.

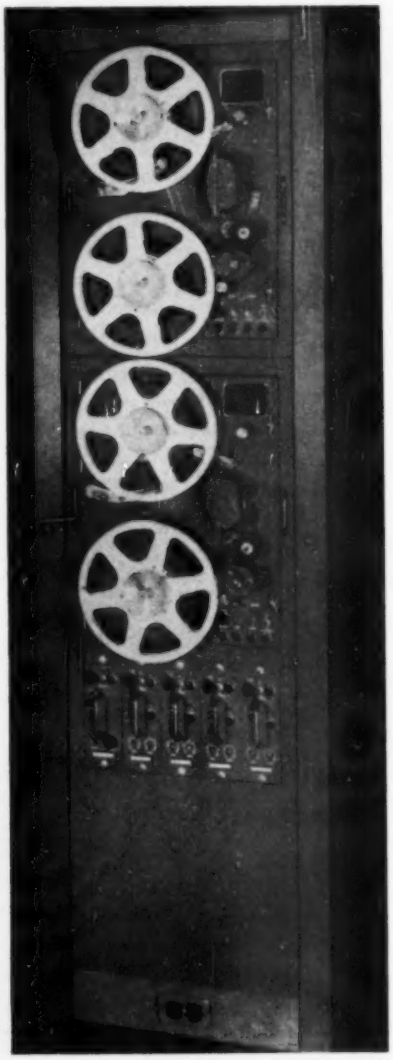
Automatic controls provide switching from one recorder unit to the other two minutes before the end of the tape. The first unit automatically stops at the end of the tape. In case of tape break, the unit shuts off and the second unit begins immediately while a light indicates the tape breakage. The entire unit may be remotely operated if desired.

The associated multi-channel playback unit is a four-track reproducer with provisions for manual or foot-switch operation. It has both normal and high speed operation in either forward or rewind directions. The reproducer amplifier has simultaneous inputs for two channels which may be selected from any one of the four tape tracks which are available.

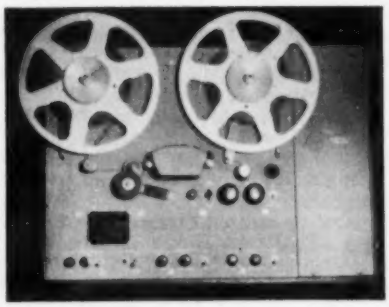
The portable bulk eraser, which is part of the system, is designed for constant operation and has a built-in blower system to keep the large internal reactors cool. Because of this feature, the unit is able to handle large quantities of tape without difficulty.

The various accessory units used in conjunction with the recorder and playback unit are designed to make the unit self-contained and self-sustaining. —30—

The rack-mounted, multi-channel "record" tape transport cabinet.



The muli-channel "reproduce" tape transport unit of the new system.



BUY TEST EQUIPMENT
ON THIS RADICALLY NEW
TIME PAYMENT PLAN
NO INTEREST!! - NO CARRYING CHARGES!!

USE CONVENIENT TIME PAYMENT ORDER BLANK BELOW

Superior's New Model 770

VOLT-OHM MILLIAMMETER

Sensitivity—1000 ohms per volt

Uses latest design 2% accurate 1 Mil. D'Arsonval type meter. • Same zero adjustment holds for both resistance ranges. It is not necessary to readjust when switching from one resistance range to another. This is an important time-saving feature never before included in a V.O.M. in this price range. • Housed in round-cornered, molded case. • Beautiful black etched panel. Depressed letters filled with permanent white. Insures long-life even with constant use.

SPECIFICATIONS:

6 A.C. VOLTAGE RANGES: 0-15/30/150/300/1500/3000 Volts.
6 D.C. VOLTAGE RANGES: 0-7.5/15/75/150/750/1500 Volts.
4 D.C. CURRENT RANGES: 0-1.5/15/150 MA. 0-1.5 Amps.
2 RESISTANCE RANGES: 0-500 Ohms. 0-1 Megohm.

Model 770 is an accurate pocket-size V.O.M. Measures only 3⅛"x 5⅞"x2¼".

$14.90 NET

The Model 770 comes complete with self-contained batteries, test leads and all operating instructions.

Superior's New Model TV-11

TUBE TESTER

• Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TV-11 as any of the pins may be placed in the neutral position when necessary. • Uses no combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket. • Free-moving built-in roll chart provides complete data for all tubes. • Phono jack on front panel for plugging in either phones or external amplifier detects microphonic tubes or noise due to faulty elements and loose external connections.

Operates on 105-130 Volt 60 Cycles A.C. Hand-rubbed oak cabinet complete with portable cover .....

$47.50 NET

Superior's New Model 670-A

SUPER-METER

A *COMBINATION* VOLT-OHM MILLIAMMETER PLUS CAPACITY REACTANCE INDUCTANCE AND DECIBEL MEASUREMENTS

SPECIFICATIONS:

D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500/7,500 Volts.
A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
OUTPUT VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes
RESISTANCE: 0 to 1,000/100,000 Ohms 0 to 10 Megohms
CAPACITY: .001 to .1 Mfd. 1 to 50 Mfd. (Quality test for electrolytics)
REACTANCE: 50 to 2,500 Ohms, 2,500 Ohms to 2.5 Megohms
INDUCTANCE: .15 to 7 Henries 7 to 7,000 Henries
DECIBELS: —6 to +18 +14 to +38 +34 to +58

Comes housed in rugged, crackle-finished steel cabinet complete with test leads and operating instructions. Size 6¼"x9⅝"x4½".

$28.40 NET

ADDED FEATURE:
The Model 670-A includes a special GOOD-BAD scale for checking the quality of electrolytic condensers at a test potential of 150 Volts.

Superior's New

TV BAR GENERATOR

THROWS AN ACTUAL BAR PATTERN ON ANY TV RECEIVER SCREEN!!

CONNECTS DIRECT TO ANTENNA POST

NO CONNECTION INSIDE RECEIVER

Features.—Can be used when no stations are on the air. • Provides linear patterns to adjust vertical and horizontal linearity • Provides vertical and horizontal sweep signals • Provides signal for testing video amplifiers.

TV Bar Generator comes complete with shielded leads and detailed operating instructions ..... Only

$39.95 NET

Superior's Model 660-A—A NEW A.C. OPERATED

SIGNAL GENERATOR

Provides Complete Coverage for A.M.—F.M. and TV Alignment

• Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 220 Megacycles on powerful harmonics. • Accuracy and stability are assured by the use of permeability trimmed Hi-Q coils. • R. F. available separately or modulated by the internal audio oscillator. • Built in 400 cycle sine wave audio oscillator used to modulate the R. F. signal also available separately for audio testing of receivers, amplifiers, hard of hearing aids, etc. • R. F. Oscillator Circuit: A high transconductance heptode is used as an R. F. oscillator, mixer and amplifier. Modulation is effected by electron coupling in the mixer section thus isolating the oscillator from load changes and affording high stability. • A. F. Oscillator Circuit: A high transconductance heptode connected as a high-mu triode is used as an audio oscillator in a high-C Colpitts Circuit. The output (over 1 Volt) is nearly pure sine wave. • Attenuator: A 5 step ladder type of attenuator is used.

• Tubes used: 1—6BE6 as R. F. Oscillator, mixer and amplifier, 1—6BE6 as Audio Oscillator, 1—6H6 as Power Rectifier. The Model 660-A comes complete with coaxial cable test lead and instructions ..... NET

$42.95 NET

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Dept. B-61, 38 Murray Street, New York 7, N. Y.

Please send me the units checked below. I am enclosing the down payment with order and agree to pay the monthly balance as shown. It is understood there will be no carrying, interest or any other charges, provided I send my monthly payments when due. It is further understood that should I fail to make payment when due, the full unpaid balance shall become immediately due and payable.

☐ **MODEL 770** ..... Total Price **$14.90**
$2.90 down payment. Balance **$2.00** monthly for 6 months.

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$11.50 down payment. Balance **$6.00** monthly for 6 months.

☐ **MODEL 670-A** ..... Total Price **$28.40**
$7.40 down payment. Balance $3.50 monthly for 6 months.

☐ **TELEVISION BAR GENERATOR** ..... Total Price **$39.95**
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$12.95 down payment. Balance $5.00 monthly for 6 months.

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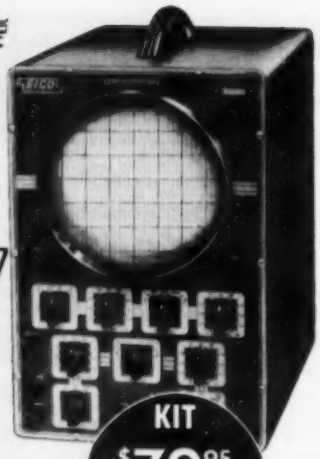
IT'S TERRIFIC!
EICO
7 MODEL 470 -INCH PUSH-PULL SCOPE



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Factory Wired $129.50

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- EXTENDED FLAT FREQ. RESPONSE: 10 cps—1 MC (-2db).
- 3-STEP FREQ.-COMPENSATED ATTENUATOR; cathode follower input.
- INTERNAL VOLTAGE CALIBRATOR; dir.-cal. screen.
- EXTENDED SWEEP RANGE: 15 cps—100 kc.
- INT. POS. OR NEG., EXT. & LINE SYNC.
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- VAR. PHASING of int. 60 cps sweep.
- DIRECT CONNECTION TO CRT PLATES.

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Dealer Inquiries Invited

Low-Pass Filter

(*Continued from page* 47)

for Channel 4. The attenuation continues to increase with frequency. The effectiveness of the filter is further demonstrated by the fact that no interference is observed on the writer's TV set on any channel. This is true even though the transmitter operates with 150 watts' input power on all bands from 160 to 10 meters and the transmitting antenna is located only a hundred feet from the television receiving antenna. It might be mentioned in passing that the writer's TV set, a *General Electric* Model 818, includes an effective high-pass filter as a part of its design.

After the work was all done, the cost of the components entering into the construction of this unit was added up. It came to less than five dollars, a most gratifying development. The most modern, "perfectly TVI-proofed" transmitter will still generate some harmonics, and this is a very small price to pay to keep them home.

—30—

Tunable Hum

(*Continued from page* 42)

on, (refer to Fig. 1) 117 volt 60 cycle a.c. was impressed across the lightning arrester terminals through the antenna primary coil and line bypass condenser. The leaky lightning arrester, acting like a nonlinear resistor, became a modulator and caused the amplitude of any broadcast signal coming down the lead-in to vary at a 60 cps rate. Enough carrier, now hum modulated, was re-radiated from the antenna connected to this lead-in to affect all receivers in the apartment house area.

Another way of looking at the phenomenon is to visualize the offending antenna as being connected to a device whose impedance varies at a line frequency rate. This might cause absorption of all r.f. signals in the vicinity. This again could be equivalent to hum modulating these carriers.

To summarize then, external hum modulation will occur in an area when:

1. An a.c. power line voltage is impressed across a semiconductor like a leaky insulator or a corroded electrical joint.

2. The leaky insulator is at the same time connected to a radiating system like a long wire or an antenna. If the power line is of the external overhead type it constitutes an excellent radiating system. See Fig. 2.

The diagnosis of tunable hum is much simpler than its localization and cure. With a portable receiver and the co-operation of the local power company and the community, this type of interference can be entirely eliminated.

—30—

Six months from today

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TO TRAIN AND COACH YOU AT HOME IN SPARE TIME UNTIL YOU GET

Your FCC License

If you have had any practical experience—Amateur, Army, Navy, radio repair, or experimenting.

● TELLS HOW-

Employers make JOB OFFERS Like These to Our Graduates Every Month

Letter from nationally known manufacturer of high quality AM and FM transmitters, "We are very much in need at the present time of radio-electronics technicians and would appreciate any helpful suggestions that you may be able to offer." Salary up to $412 per month to start.

Letter from nationally known airplane manufacturer, "We need men with electronic training or experience in radar maintenance to perform operational check-out of radar and other electronics systems . . . starting salary . . . amounting to $329.33 per month."

These are just a few samples of the job offers that come to our office periodically. Some licensed radioman filled each of these jobs . . . it might have been you!

HERE'S PROOF FCC LICENSES ARE OFTEN SECURED IN A FEW HOURS OF STUDY With OUR Coaching AT HOME in Spare Time.

Name and Address	License	Lessons
Lee Worthy 2210½ Wilshire St., Bakersfield, California	2nd Phone	16
Clifford E. Vogt Box 1016, Dania, Florida	1st Phone	20
Francis X. Foerch 38 Boucler Pl., Bergenfield, New Jersey	1st Phone	38
S/Sgt. Ben H. Davis 317 North Roosevelt, Lebanon, Illinois	1st Phone	38
Albert Schoell 110 West 11th St., Escondido, California	2nd Phone	23

Carl E. Smith, E.E., Consulting Engineer, President

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● TELLS HOW-

Our Amazingly Effective JOB-FINDING SERVICE Helps CIRE Students Get Better Jobs

Here are a few recent examples of Job-Finding results:

GETS CIVIL SERVICE JOB

"Thanks to your course I obtained my 2nd phone license, and am now employed by Civil Service at Great Lakes Naval Training Station as an Equipment Specialist."
Kenneth R. Leiser, Fair Oaks, Mtd. Del., McHenry, Ill.

GETS STATE POLICE JOB

"I have obtained my 1st class ticket (thanks to your school) and since receiving same I have held good jobs at all times. I am now Chief Radio Operator with the Kentucky State Police."
Edwin P. Healy, 264 E. 3rd St., London, Ky.

GETS BROADCAST JOB

"I wish to thank your Job-Finding Service for the help in securing for me the position of transmitter operator here at WCAE, in Pittsburgh."
Walter Koschik, 1442 Ridge Ave., N. Braddock, Pa.

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"Due to your Job-Finding Service, I have been getting many offers from all over the country, and I have taken a job with Capital Airlines in Chicago, as a Radio Mechanic."
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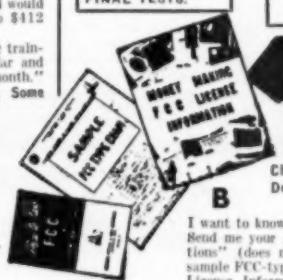

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RECEIVER AND TRANSMITTER

RECEIVER BC-229 — TRF Receiver with 3 Plug-in Coils to cover Freq. Range 201 to 398, 2500—4700, 3150—7700 KC. With 6 Tubes: 1/37—1/38—3/39. Power Supply required, 6 or 12 Volt & 250 Volts. Size: 16"x8"x7". Schematic included..... **$8.95**

TRANSMITTER BC-230—Voice modulated Trans. with 5 Plug-in Coils to cover Freq. Range 2500 to 7700 KC. With 4 Tubes: 2/10y—2/45 & RF Meter 0-1.5 Amps. Power Supply required, 6 or 12 Volt & 350 Volts. Size: 13"x8"x7". Schematic included..... **$8.95**

SPECIAL BUY—BOTH RECEIVER AND TRANSMITTER **$15.00**

ANTENNA EQUIPMENT

MAST BASES—INSULATED:

MP-132 BASE—Illustrated at left—1" heavy coil spring, 2" insulator. Overall length: 11½." Weight: 2¾ lbs. Price $3.95

MP-S-33 BASE—Insulated type with heavy coil spring and 5" dia. insulator. Requires 2" hole for mounting. Weight: 9 lbs. $5.95

MAST SECTIONS FOR ABOVE BASES

Tubular steel, copper coated, painted, in 3 ft. sections, screw-in type. MS-53 can be used to make any length with MS-52-51-50-49 for taper. Any section..... 50c Each
Larger Diameter Section: MS-54..... $1.25

DYNAMOTORS

DYNAMOTOR and BLOWER: 9 Volts DC input: output 450 Volts 60 MA. 4500 RPM. At 6 Volts DC input: output 260 Volts 65 MA. 3000 RPM. Price **$4.95**

INPUT:	OUTPUT:	STOCK No.:	PRICE:
14 V. DC	600 V. 300 MA.	BD-86	$9.95
12 V. DC	220 V. 70 MA.	DM-24	6.95
12 V. DC	220 V. 100 MA.	DM-18	4.95
14 V. DC	375 V. 150 MA.	DM-375	8.95
14 V. DC	330 V. 135 MA.	DM-330	7.95
14 V. DC	500 V. 500 MA.	PE-59	14.95
12 or 24 V. DC	275 V. 110 MA.	USA/0516	3.95
12 V. DC	250 V. 50 MA.	DM-25	8.95
12 or 24 V. DC	500 V. 50 MA.	USA/0515	3.95
12 or 24 V. DC	440 V. 200 MA. 225 V. 100 MA.	D-104	14.95
28 V. DC	250 V. 60 MA.	PE-86	5.95

TELEPHONE WIRE

3 Conductor, copper & steel, 525 ft. $4.75

REVERSIBLE MOTOR

Motor Reversible—3.7 RPM. 40 lb. torque. 24 Volt DC or AC. Motor size: 3½" x 4-1/32" x 3-5/16". Shaft size: 21/32" x 5/16". Philco No. 441-1000 ..... NEW: $5.95

110 Volt AC TRANSFORMER to operate above motor..NEW: $4.95

COMMAND EQUIPMENT

BC-459 Transmitter—7 to 9 MC.—Used..... 14.95
BC-455 Receiver—6 to 9 MC—Used..... 10.95
BC-456 Modulator..NEW: $5.95—Used..... 2.95
Transmitter Rack—Single: $1.50—Dual..... 2.00
Rec. Rack—Triple: $2.50. Modulator—Mtg..... 1.50
Rec. Dyn.—Used: $2.95. Trans. Dyn.—Used..... 2.95

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RA-10 DA RECEIVER..... NEW: 49.95
RT7/APN-1 Transceivers—420 MC. Complete with Tubes & Dyn..... NEW: $24.95—USED: $19.95
ARC-4 Transceiver—140-144 MC. w/Tubes—Used: $29.95
BC-1206—200-400 KC. Delco. w/Tubes..... 9.95
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BC-709—W/Tubes—New: $4.95..... Used: 3.95
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6 or 12 Volt

(Reprints of original CQ conversion articles — Oct. and Dec., 1952 issues, furnished.)

• This is the Dynamotor the Hams have been talking about! Easily adapted to supply 625 V. @ 150 MA. and 325 V. 125 MA. at 12 Volts—or 300 V. 90 MA. and 160 V. 110 MA. at 6 Volts. (Illustration shows modified.) NEW: $4.95

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VIBRATOR TYPE—6 Volt DC input: output 230 Volt DC 50 MA.—not filtered—w/tube. Ideal for Command Receiver operation as receiver is filtered internally. Size: 4½" x 4¼" x 3½"..... $5.95

PE-157 POWER SUPPLY—2 Volt Vibrator Supply, operates from BB-54 2 Volt Battery mounted in Case. Output voltage 1.4 V. ½ Amp. 125 V. 50 MA. Less Battery, Speaker, & External Power Cord—with Vibrator ..... Used .$4.95

MP-28 BA Power Supply & Modulator f/TA-12—New: 29.95

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3/32"—7x7 Strand, Weatherproofed, Galvanized, Preformed, 920 lb. test. Ideal for Television Guying and many other uses. Prices:

4½c per Ft.—1000 Ft. or more @ 4c per Ft.

BLOWERS—115 VAC 60 CYCLE

SINGLE TYPE: (Illustrated at left) 100 CFM. 2½" intake: 2" outlet. Complete size: 5" x 6". Order No. 1C939..... $8.95

DUAL TYPE: 160 CFM. 4" intake; 2" Dia. Each Side. Complete Size: 8" x 6". Order No. 1C680..... $13.95

COMPACT TYPE: 100 CFM. Motor built inside squirrel cage. 4½" intake; 3¼" x 3" Dia. Complete size: 4¼" W x 8⅝" H x 8⅛" D. Order No. 2C067..... $14.50

FLANGE TYPE: 140 CFM. 3½" intake; 2½" Dia. Complete size: 7½" W x 7¼" H x 6¼" D. Order No. 1C807..... $13.95

FLANGE TWIN: 275 CFM. 4½" intake; 3¼" x 3" Dia. Complete size: 11¾" W x 8⅝" H x 8-1/16" D. Order No. 2C069..... $21.95

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TRANSFORMERS—110 V. 60 CYCLE PRIMARIES:
5 Volt CT-25A—10,000 V. Ins. OPEN FRAME—6" x 5" x 4½"..... $7.95
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24 V. ½ Amp.....1.50 — 24 V. 6.5 Amp..... 5.95
6—24—or 30 Volt 8 Amp..... 5.95
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By RONALD L. IVES

IN MAINTENANCE, repair, and experimental work, the need frequently arises for low a.c. voltages which are isolated from ground. The standard method of securing these voltages is by use of an isolation transformer and a Variac. This combination works excellently, is highly dependable and convenient, and costs about $35.00.

To reduce costs, many experimenters connect two small filament transformers "back to back," inserting a rheostat or potentiometer in the low-voltage intermediate circuit to permit variation of the output voltage, as in Fig. 1A. Within the ratings of the transformers and resistor, this expedient works quite well, and costs less than $10.00 in most instances.

Most service shops, however, already have available a tapped isolation transformer, equipped with means for varying the output voltage both in steps and continuously! Such a transformer is an integral part of most tube checkers of better manufacture, and an additional expenditure of less than $1.00 will make these voltages available for test and experimental work. All that is needed is a means of tapping into the filament circuit of the tube checker.

A generalized circuit of a tube checker filament supply is shown in Fig. 1B. To obtain the various voltages, a plug connector can be wired to fit any socket, such as the octal, with lead wires connected to the 2 and 7 pins. When the controls are set for a 6J5, or any other octal tube with similar filament connections, the voltage across these leads will be that produced by the filament transformer, the actual value being a function of the setting of the filament voltage switch and of the line adjustment.

A slightly more elegant method is to mount a terminal, such as an Eby 21-R or a National R-39, at some convenient place on the panel, and then to wire it directly across the filament leads of the checker. Voltage will be determined by filament voltage switch and line adjuster settings, and will be independent of the other settings.

If the tube checker is not already equipped with a fuse, one should be installed, to prevent transformer burnout in event of an accidental short circuit. Replacement fuses cost three cents: replacement transformers cost $8.00 and up, mostly up. —30—

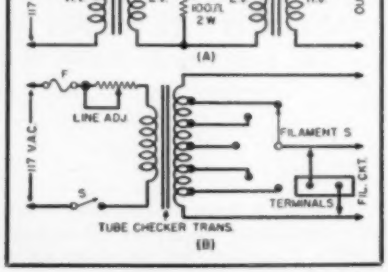

Fig. 1. (A) Standard method of varying output voltage. (B) Tube checker filament supply with the adaptations to permit its use as a variable output low voltage source.

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See Foot Note

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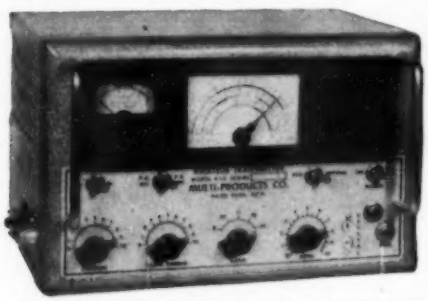

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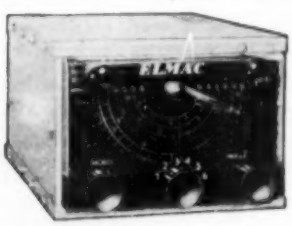

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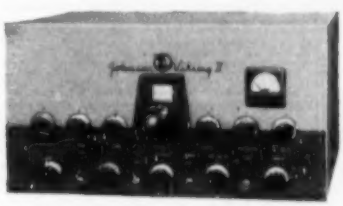

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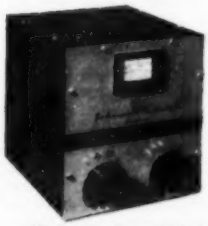

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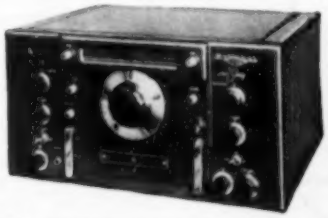

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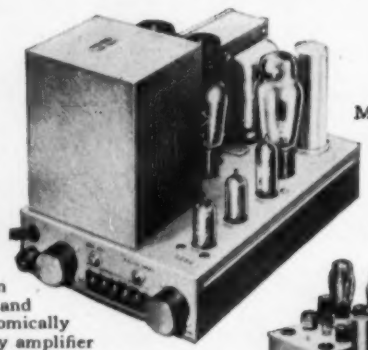

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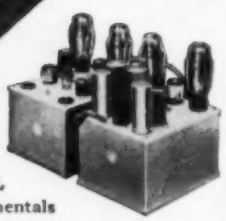

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Oscilloscope Calibrator

(Continued from page 71)

inch, etc. However, if the user is dealing with waveforms of widely varying amplitudes, this method is inconvenient and can easily lead to errors. A second method, and one which makes more use of the calibrator, involves observing the waveform under measurement with the scope gain set to view the waveform at any convenient height. The calibrator can then be switched from the "Scope" position to the "Cal" position whereupon the calibrated pot is adjusted to produce the same height as the previously observed waveform. The dial and multiplier readings on the calibrator are noted. These two readings when multiplied together give the peak-to-peak voltage of the observed waveform.

The use of this instrument is readily extended to make it even more useful. By adjusting the grid resistor and coupling condensers of the multivibrator to produce a specific frequency, a convenient signal source for square-wave testing of audio amplifiers is obtained. The device can also be used for both r.f. and a.f. signal tracing since the square-wave output is so rich in harmonics. However, if it is used for this purpose, it is essential that condensers be included in series with both leads connected to the output of the calibrator.

Probably even more uses, other than its intended purpose will suggest themselves to the constructor, thus making this unit a very worthwhile addition to anybody's shack, shop, or laboratory. —30—

WORLD RADIO USE TOTALS

OVER half the radio receivers in the world are located in the U.S., according to the recently-published United Nations Statistical Yearbook for 1952. As of 1951, the latest year for which totals were available, there were an estimated 105,000,000 home and public-entertainment sets in operation here, exclusive of TV and other special receivers. Since the totals for the various countries include individual loudspeakers fed by central distributing receivers (of the type used for public information and entertainment in some countries) the American portion of the world total is probably greater than it appears statistically.

Some nations, including the U.S., have shown an enormous gain over available statistics for 1938. In this country the 1951 figure is two and a half times the 1938 estimate. In 1951 there were twice as many radios as prewar in Japan, Czechoslovakia, Australia, and Canada and nearly twice as many in Sweden. France and the United Kingdom showed increases of 57 and 50 per-cent respectively. The most striking increase was recorded by Italy, the 1951 figure being 280 per-cent higher than in 1938.

No figures on set ownership were available from the USSR.

This report again underlines the importance of radio in disseminating information. —30—

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1A5GT	.79	3Q4	.69	6AX5	.79	6J5GT	.59	6SS7	.99	7J7	1.19
1A7	.69	3Q5GT	.89	6AX6	.69	6J6	.79	6T7G	1.15	7K7	
1A7GT	.79	3S4	.69	6AY5GT	.89	6J7G	.69	6T8	.89	7L7	.79
1B3GT	.99	3V4	.95	6B4G	1.44	6J8G	1.15	6U5	69c	7N7	.69
1B5	.29	5T4	1.40	6B8GT	1.15	6K5GT	.69	6U6GT		7Q7	.79
1N5GT	.59	5U4G	.59	6BA6	.59	6K6GT	.59	6U7G		7R7	1.19
1J6GT		5V4G	.87	6BA7	69c	6K7GT	.69	6U8		7S7	1.19
1L4	69c	5W4	59c	6BC5		6K8GT	1.19	6V3	1.29	7V7	.79
1L6		5W4GT		6BC7	1.05	6L5G	.95	6V6GT	.69	7W7	1.19
1LA4	1.19	5Y3GT	.45	6BD6GT	.89	6L6G	95c	6W4GT	.59	7X6	1.05
1LA6	1.19	5Y4G	.54	6BE6	.59	6L6GA		6W6	.69	7X7	79c
1LC5	.69	5X4G	.89	6BF5	69c	6L7	1.19	6X4	59c	7Y4	
1LC6	1.19	5Z3	81c	6BF6		6N6G	1.40	6X5GT		7Z4	.89
1LD5		6A3	1.68	6BG6G	1.69	6N7GT	1.19	6Y6G	.69	12A7	1.59
1LE3	1.19	6A7	1.21	6BH6	69c	6P5GT	.69	6Z4/84	.72	12A8	.69
1LH4	1.19	6A8GT	69c	6BJ6		6Q7GT	.59	7A4	.95	12AH7	1.38
1LN5	1.19	6AB4		6BK7	1.19	6R7GT	.69	7A5	1.19	12AL5	.54
1N5GT		6AB7	1.15	6BL7	.79	6S4	.59	7A6	.89	12AT6	.59
1P5GT		6AC5GT	.89	6BN6	1.19	6S7GT	.89	7A7	79c	12AT7	.89
1Q5GT	79c	6AC7	1.45	6BQ6GT	.85	6S8GT	1.25	7A8		12AU6	.69
1R5		6AG5	1.05	6BQ7	1.29	6SA7GT	69c	7B4	.89	12AU7	.79
1S4	.99	6AG7	1.49	6BZ7		6SC7		7B5	.89	12AV6	.59
1S5		6AH6	1.89	6C4	.59	6SD7GT	.99	7B6	.89	12AV7	.89
1T4	69c	6AK5	.89	6C5GT		6SF5	.59	7B7	89c	12AW6	1.19
1U4		6AK6	1.08	6C6	69c	6SF5GT	.59	7B8		12AX4	.69
1U5	.59	6AL5	69c	6C8G		6SG7	69c	7C4	1.38	12AX7	.69
1V	.88	6AQ5		6CD6G	1.69	6SH7		7C5	.89	12AY7	$1.95
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2A6	89c	6AR5	.79	6D8G	1.15	6SJ7	.79	7C7	79	12BA7	1.19
2A7		6AT6	.59	6E5	.69	6SJ7GT	59c	7E5		12BE6	69c
2B3	.89	6AS5	.90	6F5GT	59c	6SK7GT		7E6		12BF6	.69
2B7	.89	6AU5GT	1.29	6F6GT		6SL7GT	.69	7E7		12BH7	.69
2C34	.60	6AU6	.59	6F7	1.59	6SN7GT	.69	7F7	.89	12BY7	.89
2E5	.89	6AV5GT	.89	6F8G	1.59	6SQ7	.59	7F8	1.47	12BZ7	1.19

12F5GT	.65	12SH7GT	.79	25A7G	1.19	50A5	1.05	83	.45	1B24/707	1.49
12H6	.99	12SJ7GT		25AC5GT	1.04	50B5	69c	84/6Z4	.72	1B27/708	1.49
12J5GT	.75	12SK7GT	69c	25B06GT	1.15	50C5		85	.79	1B32/710	1.49
12J7GT	.69	12SL7GT		25L6GT	.59	50C6G	1.39	VR90		1B40/711	1.49
12K8	.89	12SN7GT	.99	25W4GT	.69	50L6GT	.69	VR105	$1.19	1B41/712	1.49
12Q7GT	.89	12SQ7GT	69c	25Z5	.69	50X6	.69	VR150		1B42/713	1.49
12SA7GT	.69	12SR7GT		25Z6GT	.69	50Y6	.99	VT61	29c	1B44/714	1.49
12SC7	1.05	12V6GT	.69	32L7GT	1.15	57	79c	VT62		1B46/715	1.49
12SF5GT	.69	12X4	.69	35/51	.79	58	1.49	117L7	.140	1B47/716	1.49
12SF7	.99	14A4	1.05	35A5	.99	70L7		117N7	1.95	1B48/717	1.49
12SG7	.89	14A7	.93	35B5	69c	70L7GT	1.49	117P7	1.95	1B49/718	1.49
12SH7	79c	14B6	89c	35C5		71A	.87	117Z3	.59	1B50/719	1.49
12SJ7GT		14C5	1.25	35L6GT	.59	75	.79	1629		1B51/720	1.49
12SK7GT		14C7	1.12	35W4	99c	77	.69	1629	29c	1B52/721	1.49
12SL7GT		14F7	1.05	35Y4		78/6D6	1.10	2050	2.00	1B53/722	1.49
12SN7GT		14F8	1.45	35Z3	79c	80	.69	2051	1.15	1B54/723	1.49
12SQ7GT		14H7	1.12	35Z5	1.49	7193	.87				
12SR7GT		14Q7	1.29	70L7GT							
12V6GT		14W7	1.19	71A							
12X4		14X7	1.19	75							
12SH7GT		19B06G	1.69	77							
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Write to us for the reprint of the informative scope article that appeared in the January 1953 issue of RADIO & TELEVISION NEWS. If you want a copy, drop us a line and one will be shipped to you post haste.

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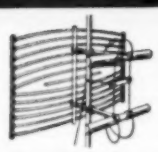

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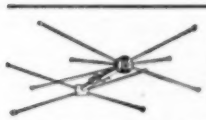

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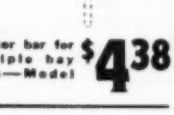
UNIVERSAL OUTPUT TRANSFORMER, 12 watt 99c
CHIMNEY MOUNT for TV ant. 98c
6-foot LINE CORD UL ..... 10 for $1.95
TV INTERLOCK CORDS ..... ea. 49c

300 OHM TWIN LEAD

55 Mil, 100 ft. ..... $ 1.59
1,000 ft. 11.95
20 Ga. 80 Mil, 100 ft. 1.89
1,000 ft. 16.95
TUBULAR 300 OHM LINE
1,000 ft. $34.50
100 ft. $4.95

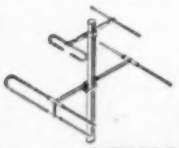
Radelco

Ultra High Gain TV Antenna



with famous director bar for single and multiple bay stacked arrays—Model RS-751 BAR X $4.38

RADELCO HI-LO Model RM-40-S



High Channel Dipole & Reflector, Low Channel Dipole & Reflector, Five foot mast, U-Bolt Mtg.
All Channel $5.76

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12AT6, 5 Tubes for $2.59
50L6GT, 35Z5GT, 12SQ7GT, 12SK7G, 12SA7G. 5 Tubes for $3.22

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6" SPECIAL PRICE		... ea.	$1.79

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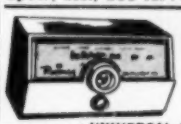

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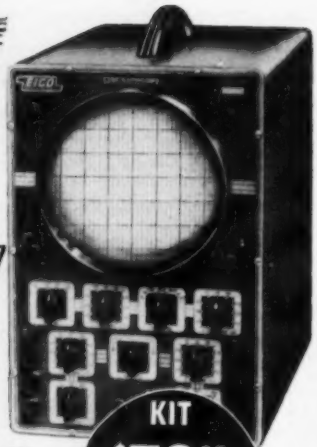

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DYNAMIC NOISE SUPPRESSOR

By T. B. COUCH

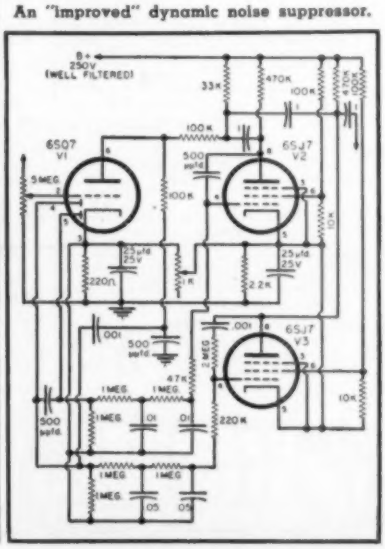
THE purpose of this article is to show how the dynamic noise suppressor may be improved over past designs. Circuits of this type have suffered from a variety of undesirable effects; notable among these was the introduction of distortion products that were not present in the original transmission. Among these effects is the so-called ringing produced by the chokes when the gates were opening and closing and also there were noticeable thumps, swishing, and "on-off" effects. It is the opinion of the author that this circuit is free of these defects that have characterized dynamic noise suppressors in the past.

The first basic change, it will be noticed in the diagram, is that the two chokes are missing from the circuit. This can be accomplished by increasing the phase shifting condenser to a larger value. Increasing this condenser value determines the maximum amount of suppression and it can be made variable to suit the needs of the listener. The coupling condensers, from the respective gates are larger in value, to extend both the high and low end when the gates are open. The timing circuits have been made fast acting in order to follow rapid variations in the music but not too rapid to distort the shimmer of a loud passage.

The frequency selective networks associated with the control amplifier are the same as in past circuits and are adequate for this improved version of the dynamic noise suppressor.

All records have a definite background noise which increases with wear, detracting from the original performance. The use of this suppressor with modern long playing type discs and older shellac pressings will improve the signal-to-noise ratio without any of the undesirable defects mentioned previously. Circuit details have been omitted because the dynamic noise suppressor has been explained many times in the past. The author uses this unit in a modern wide range system and has found it quite adequate for all program material, including live FM. —30—

An "improved" dynamic noise suppressor.



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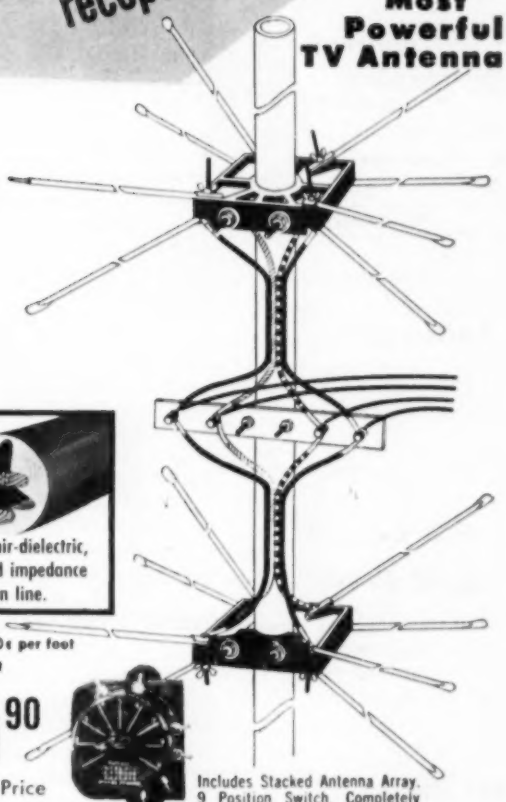

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- **Receives channel 2-83 from all directions without a rotor.**
- **Broadband UHF-VHF and FM, motorless all direction reception.**
- **All aluminum flip-out assembly.**

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Approx. 300 Ohms between every two of the four conductors.

Four conductor air-dielectric, tubular, matched impedance transmission line.

4 Conductor Tubular Wire 10¢ per foot
$8.90 per hundred feet

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☐ Please put my name on your "Special Bargain" mailing list.
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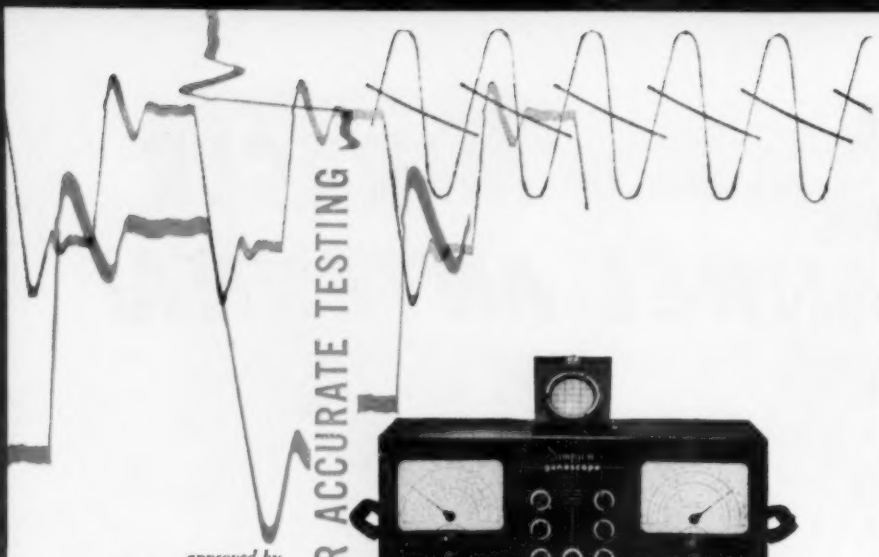

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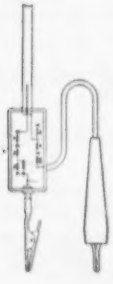

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Mac's Service Shop

(Continued from page 68)

absolutely impossible with the older instruments.

"For instance, a scope with a ten-millivolt sensitivity will produce an inch-high trace with only one one-hundredth of a volt r.m.s. applied to the vertical amplifier. That means it is many times more sensitive than the a.c. meters usually found around a service shop. A very tiny voltage, such as that put out by a crystal microphone, is more than sufficient to drive the trace beyond the limits of the screen. In working on an amplifier, such a scope can be used to trace the signal from the input to the output.

"And high-frequency waveforms can be examined as easily with our modern scope, that has a sweep generator going up to 100,000 cycles, as could the line voltage sine wave with the older instruments. You proved that the other day when you were looking at the r.f. waveform put out by our signal generator. Even when the generator was working at several hundred kilocycles you were able to display just a few cycles on the screen."

"Yes," Barney broke in, "and I remember your using that scope to show George what was wrong with his sweep generator when he kept hollering because when he lined up a set with the sweep generator so that the response curve of the i.f.'s looked perfect, the set would not work right, and when he looked at the i.f. pass-band curve of a set that was OK, the curve bore no resemblance to anything living or dead. You put the crystal probe on the scope and looked at the voltage produced across the output of the signal generator while the wide sweep was being used and found a bad hump in the output around twenty-four megacycles because of a wrong terminating resistor. When George adjusted the i.f. trimmers so that this hump did not show, he was actually producing a deep dip in the true response curve at the hump frequency. You could not have made this test with an insensitive scope."

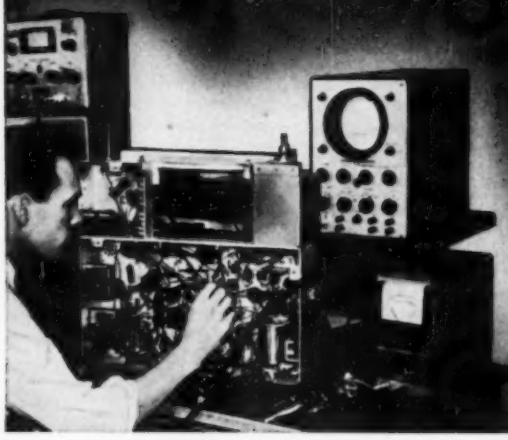
"You get the idea," Mac complimented him. "Technicians should remember that service instruments are like little girls: they grow up and often improve greatly, and just because you were acquainted with one away-back-when is no sign that you would even recognize an up-to-date version."

"Yeah man!" Barney said with the enthusiasm he always displayed when the subject of girls was mentioned. "Not to change the subject, though, what is that new little shelf for over there in the corner?"

"You're not changing the subject," Mac said with a grin. "That is for our 'new' second-hand test instrument: a small communications receiver."

"And that is a test instrument?" Barney marvelled.

For opportunities within your reach



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The RCA Institutes course was written and planned by instructors with years of specialized experience in training men by home-study and resident-school methods. The course embodies RCA's background of television experience plus knowledge gained in training several thousand technicians. A study of the course parallels an apprentice's training. Your lessons are carefully examined and accurately graded by friendly teachers who are interested in helping you to succeed.

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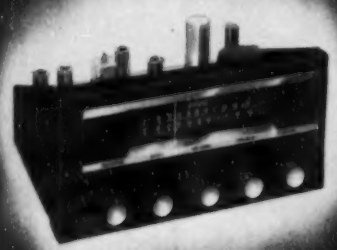

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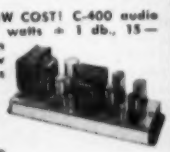

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"It will be as we use it. In the first place the good engineering and the complete shielding of the set will make it an 'ideal' broadcast receiver with which we can compare house receivers we work on. When we want to know if a certain noise or interference is originating outside of the set, a quick check with this communications job will tell us. Then, too, you will notice the small coaxial cable that runs from the bench over to the set and can be either connected to the antenna terminals or to the plug in the 'phones' jack. That enables us to run a signal from the bench into the receiver or a signal from the receiver back to the bench."

"What's the good of that?"

"The bench-to-receiver connection will allow us to check our r.f. generators for accuracy whenever we wish. For rough checks, we can flip on the receiver's beat-frequency-oscillator so we can hear the generator output and depend upon the dial calibration itself, which will be plenty good enough for most of our uses. When we want really accurate checks, we can tune in WWV on 2.5, 5, 10, 15, 20, 25, 30, or 35 megacycles—the receiver tunes from 540 kc. to forty megacycles—and then beat either generator fundamentals or harmonics against the standard frequency stations to produce checks on almost any frequency we want.

"When the receiver-to-bench connection is in use, we can use the 440 and 600 cycle tone modulation of WWV to check our audio generator by comparing its output with these standard frequencies when the two outputs are combined in Lissajous figures on the scope."

"Yeah, and if a customer wants to hear his set before he pays for it, and if someone in the neighborhood happens to be running an electric drill at that particular moment, we can prove to him that the noise is not just in *his* set," Barney pointed out.

"And of course," Mac remarked, "it will come in mighty handy for picking up the ball games—but of course you would never think of that."

"Of course not," Barney agreed. —30—

Preamp-Equalizer

(*Continued from page* 46)

ma., a dry disc rectifier supply with a 7.5 volt transformer, as shown in Fig. 4A is most applicable when d.c. is required. The remaining heaters should not be operated from the d.c. side of the supply as the ripple would substantially increase. An alternative, shown in Fig. 4B, may appeal to some experimenters. 12AU6's can be series operated from a 150 ma. source if this type is used instead of the 6U8.

Construction

An infrequently used method of construction is shown in the accompanying illustrations. This method greatly facilitates wiring and maintenance as well as ensuring a professional appearance. Along with many others, the writer experiences as much, if not greater, satisfaction from the building process as from the performance of the completed unit. Even so, wiring does become tedious and much thought was given to correcting some of the wiring and parts placement difficulties with a mechanical arrangement that permits simpler and more positive techniques. The sub-assembly method permits the bulk of the parts mounting and wiring to be negotiated in the open with a freedom uncommon to point-to-point chassis wiring.

The writer wishes to thank the many persons who have expressed their interest in the preamplifiers heretofore described and who have offered suggestions for their improvement.

Special gratitude is offered to Mr. Uolevi Lahti of Ann Arbor, Michigan, whose unusual interest and activity in the high fidelity sound reproduction field has made possible the many listening tests and inspiration resulting in the unit described in this article.

REFERENCES

1. Rose, Arthur J.: "Front End Control Unit for Williamson Amplifier," Radio & Television News, June 1952.
2. Read, Oliver: "The Recording and Reproduction of Sound," Howard W. Sams & Co., Inc., Indianapolis. Page 478.

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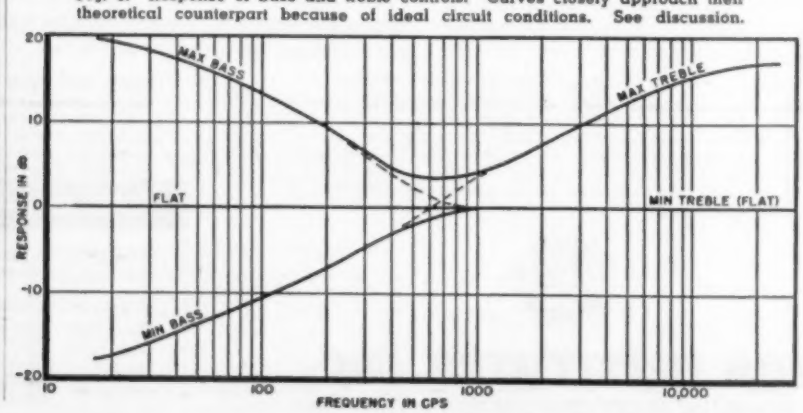


Fig. 5. Response of bass and treble controls. Curves closely approach their theoretical counterpart because of ideal circuit conditions. See discussion.

Noise Immunity Circuits

(*Continued from page 55*)

nal. Thus, this system can adapt itself to both weak and strong signals, as required.

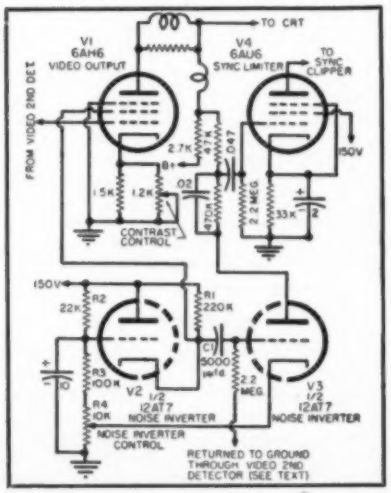
Bendix Circuit

Bendix TV receivers have a noise suppressor system which attacks the problem from still another angle. The entire circuit revolves about a twin-triode 12AT7. See Fig. 4. The first section, V_2, actually is placed in shunt with the screen dropping resistor, R_1, of the video output amplifier, V_1. The bias for V_2 is established by the voltage divider network R_2 (22,000 ohms), R_3 (100,000 ohms), and R_4 (a 10,000-ohm potentiometer). The cathode of V_2 connects directly to the screen grid of the video amplifier and since the screen grid is not bypassed to ground, a certain amount of voltage variation will occur across R_1 as the signal changes. The bias chosen for the grid of V_2 will permit this tube to conduct varying amounts depending upon the signal reaching the cathode of V_2. This, in turn, will vary V_2's shunting effect on R_1 with the net result that the voltage at the screen grid of V_1 will remain fairly constant until a strong noise pulse comes along.

Also coupled to the screen grid of V_1 is the grid of V_3. This is accomplished through C_1, a 5000 μfd. condenser. V_3 will therefore receive the voltage variations present at the screen grid of V_1 but its cathode voltage has a sufficiently high positive voltage so that V_3 is normally non-conductive. R_4, the noise inverter control, establishes the positive voltage of the cathode.

The circuit is now set for the arrival of a strong noise pulse and when this occurs, it drives V_1 sharply into cut-off. (Sync pulse polarity at the grid of V_1 is negative.) This allows

Fig. 4. Noise suppressor circuit used by Bendix in its models 0AK3, 21K3, 21KD, 21T3, and 21X3 television receivers.



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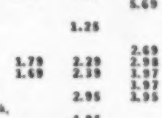

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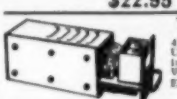

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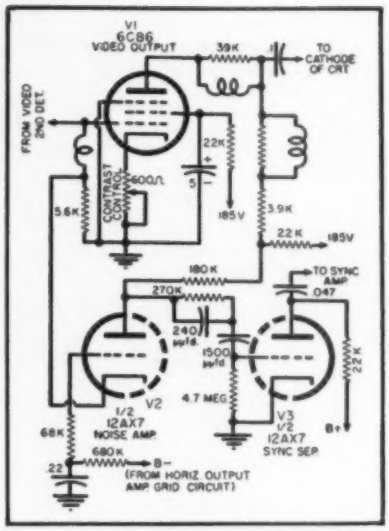

Fig. 5. Noise suppression circuit used by Magnavox. Noise pulses traveling through two paths to the sync separator grid meet there out-of-phase and cancel each other.

the voltage at the screen (and plate) of V_1 to rise sharply. The screen grid positive pulse, reaching V_2, drives this tube into cut-off, removing its shunting effect and, in essence, raising the screen-grid potential still farther. The grid of V_2 also receives this positive pulse, bringing it sharply out of cut-off. The resulting negative pulse at the plate of V_2 combines with, and tends to cancel out, the positive noise pulse which is traveling from the plate of V_1 to the grid of V_4, the sync limiter.

Thus, the circuit has achieved the basic goal of reducing and even preventing strong noise pulses from reaching the sync limiter.

The setting of the noise inverter control will determine when V_2 is brought out of cut-off. Too low a setting could result in picture instability because some of the sync pulses will be depressed or even removed. Too high a setting will prevent V_2 from acting except on extremely strong noise pulses. Hence the control must be set carefully to obtain full benefit from this system.

Part of the bias on V_2 is controlled automatically because the grid is returned to ground through the video detector circuit. Signal polarity in the video detector circuit is negative which means that the average negative voltage that the grid of V_2 receives will vary with signal strength. This merely means that it will require a stronger noise pulse to bring V_2 out of cut-off when the video signal is strong and a weaker pulse when the incoming signal is weak.

Magnavox Circuit

The versatility of vacuum tubes and the ingenuity of engineers result in an almost endless variety of circuits. A noise suppressor circuit developed by *Magnavox* is shown in Fig. 5. The noise amplifier, V_2, is one-half of a 12AX7 which functions as a grounded-

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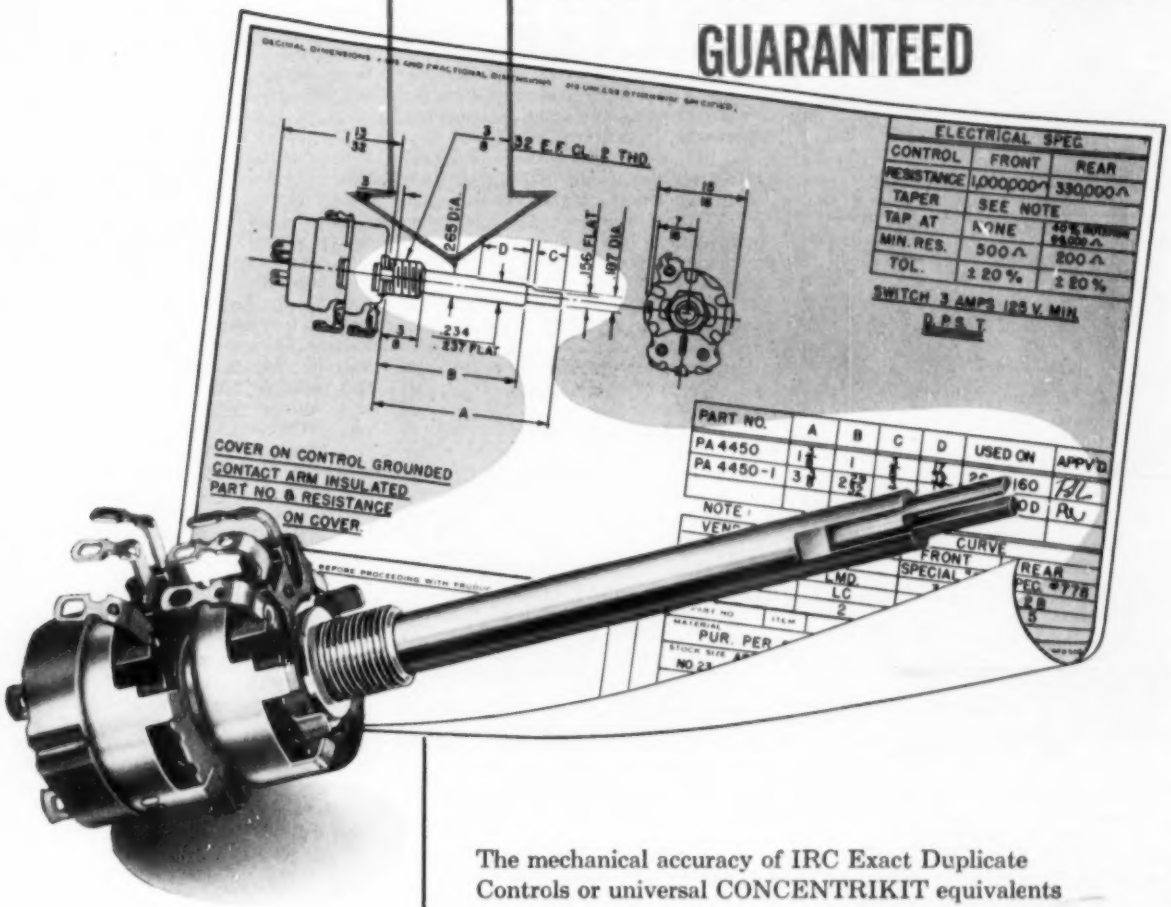
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grid amplifier circuit. A portion of the video signal (from the video second detector) is applied to the cathode of V_3. However, the grid of V_3 is biased sufficiently negative so that the tube will not conduct on normal signals.

At the arrival of a strong noise pulse, the cathode is driven sufficiently negative to bring the tube out of cut-off and the negative pulse will appear at the plate of the tube and also at the grid of V_5, the following sync separator. (In a grounded-grid amplifier, the signal receives some amplification but no reversal in polarity.)

At the same time, the sync separator receives its normal signal from the plate circuit of the video amplifier, V_1, and at this point the noise pulse polarity will be positive. Thus, the negative pulse from V_2 will offset the positive pulse from V_1.

It is evident from the foregoing explanation that V_3 forms a shunt path around V_1 to V_5 and when strong noise pulses come along they travel through both paths, meeting at V_5. The path through the video amplifier, V_1, results in signal reversal while the path through V_3 does not. Hence, when the signals meet at V_5, they cancel out. Normal signals do not pass through V_3 and are thus not subject to this action. —30—

BOOST FOR TECHNICIANS

THE TUBE DEPARTMENT of General Electric Company has, for the past year, been lending a strong right arm to help combat the unfavorable publicity which has been heaped on service technicians by the popular press.

The program, which has attracted widespread attention from set owners, service technicians, and trade organizations, consists of a series of ads in leading consumer publications, mailing pieces for dealer use, a booklet addressed to the set owner, and cooperative billboards.

The over-all response to the program has been favorable and most dealers report that the public relations program is doing yeoman service in helping to moderate customers' attitudes regarding technicians and promote a better understanding of what is involved in TV servicing. —30—

MORE EQUALIZER DATA

FROM Budd Meyer of Brooklyn, New York comes additional information to supplement the article "New Developments in Phono Equalizers" by Charles P. Boegli (page 54, April 1953 issue).

"Vox" recordings use the same equalization curve as the "Columbia" LP's. Most of the "Urania" discs use the "Columbia" LP with some "AES". The catalogue indicates which recordings use the "AES" curve. The company also indicates that record envelopes will carry the information on the curve used.

"Remington" uses the "NARTB" curve.

While no authoritative word has been received from "Decca," it is reliably reported that the 9000 series was recorded at "close to the NARTB curve."

Our thanks to Mr. Meyer for providing this additional data. We hope that it will prove of service to readers constructing the phono equalizers outlined in Mr. Boegli's article. —30—

D.C. Distribution

(Continued from page 51)

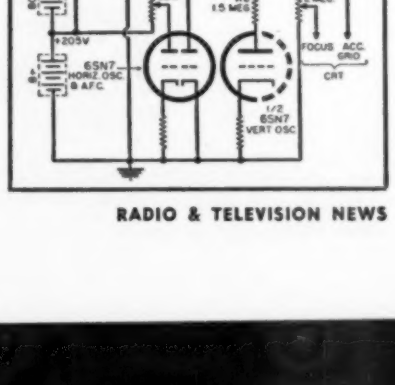
ter understanding they are shown in Fig. 6C as if C_1 were not in the circuit. At point C, the output of the filter, the high pulses have been smoothed out resulting in an additional d.c. voltage of 150 volts. This is in series with the 250-volt "B+" so that the total voltage to ground at point C measures 400 volts.

The positive pulses are of very short duration and the amount of current which can be obtained from the boost source is limited, especially since the plate current of the horizontal output tube, which comes from the boost, ranges from 60 to 100 ma. The simplified d.c. presentation shown in Fig. 6A indicates that this boost supply furnishes about 10 ma. at 400 volts. In some receivers the boost voltage may be higher, ranging up to 600 volts, and the current drain from this source varies between 5 and 25 ma. Where a larger current is used, the boost voltage is usually lowered and the HV and sweep efficiency of the flyback circuit is somewhat impaired. Loading down the boost or insufficient boost voltage causes a number of defects, all of them traceable with d.c. measuring techniques.

Fig. 7 shows a simplified d.c. distribution network for boost voltage, as used in the *Emerson* models 700B and 701B, among others. The maximum current is obtained from the boost without seriously affecting the HV and sweep performance. All this current, about 25 ma. in this instance, is needed to operate the horizontal and vertical saw-tooth generators and the accelerating and focusing elements in the picture tube. To further filter the boost voltage, a filter consisting of R_1, C_1, and C_2 is added. Both sections of the horizontal oscillator tube obtain their plate voltages from the boost, but through fairly large plate resistors. The total current drain from this circuit is small, since a blocking oscillator is used which is cut off during a large part of each cycle. The other half of the 6SN7 is the a.f.c. control tube which normally draws only 1 or 2 ma.

The vertical oscillator employed in this receiver is a multivibrator, but

Fig. 7. Boost voltage distribution as found in some of the Emerson receivers.



since only one triode section is connected to the boost voltage, only that tube is shown in Fig. 7. Because of the large plate resistors, R_5 and R_6, this tube draws very little current. Similarly, the focus element and accelerating grid in the picture tube draw negligible current.

The most frequent defect of this system is low boost voltage. Assume that the horizontal output amplifier or the damper tube has become slightly weak, reducing the amount of boost voltage available. This immediately lowers the output of the horizontal oscillator and the driving signal on the horizontal output tube. This results in less output voltage, less horizontal deflection, and still less boost voltage. This leads to a vicious circle which can result in very poor HV, insufficient horizontal sweep, and even poor vertical sweep. The accelerating grid and focus element in the picture tube are not too voltage sensitive, but if the boost drops by 50 or 100 volts poor brightness and focus will result.

Assume in the circuit of Fig. 7 that C_3 shorts out. This will lower the boost voltage down to the "B +" level, reduce the output, and change the frequency on the horizontal deflection. The raster may be lost entirely, or it may appear only dimly and badly distorted. Another likely defect is that C_2, an electrolytic condenser, shorts or opens. In the first instance, R_1 will tend to burn up because it will be passing too much current. If C_2 opens the filtering action is removed, causing horizontal pulses to appear together with the boost voltage. The effect of these pulses will be to cause instability in the vertical oscillator, producing pairing or vertical jitter in the picture. Horizontal jitter can also result if the horizontal oscillator is set to lock at the edge of its range.

As was pointed out before, simple d.c. measurements are usually sufficient to locate most of these defects. Such measurements can be made in the customer's home and require only a v.o.m. There are short cuts and detours in d.c. measurements and some of the most important ones are presented here.

D.C. Measurements

Unless a v.t.v.m. is used it is important to know the resistance of the voltmeter. Some meters, like the *Triplett* model 625-N, have two ranges, one for 10,000 ohms-per-volt and one for 20,000 ohms-per-volt. For the latter range the voltage reading is divided by 2. The ohms-per-volt rating becomes important when small voltages are measured across circuit elements which have much more resistance than the meter. For example, assume we are measuring a 2-volt grid bias across a 100,000-ohm grid resistor. Even on the 20,000 ohms-per-volt scale the d.c. resistance of the meter is only 40,000 ohms for the 2-volt range being used. The circuit resistance is 100,000 ohms, therefore the

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meter, which shunts the grid resistor, reduces its effective value to less than 40,000 ohms, thereby reducing the 2 volts. This shows that such a voltage measurement is not at all correct and, in actual practice, grid voltage should not be measured with a simple voltmeter. A v.t.v.m has an input impedance of 5 to 10 megohms, irrespective of voltage range, and is therefore usable for grid bias measurements. In most TV circuits, however, the actual grid bias need not be measured since the plate voltage and current are a clear indication of grid bias.

Most v.o.m.'s can also be used to measure d.c. current. To make current measurements the d.c. path in the receiver must be broken and the meter must be connected in series with this circuit. This means unsoldering leads, connecting clip leads, and finally resoldering—an undesirable process. The trick in measuring d.c. current lies in making use of series resistors in the circuit and measuring the voltage across them. This method was used in the discussion of single-stage troubleshooting, utilizing the cathode resistor. All tube current flows through this resistor and the d.c. voltage across it is easily measured even with a simple 10,000 ohms-per-volt meter. Since cathode resistors for sound and i.f. amplifiers are usually about one hundred ohms, the loading effect of a 10,000 ohms-per-volt meter is negligible and any error will be small. The use of Ohm's law will give the current through the resistor. Remember that the plate and screen current add up to the current through the cathode.

Another convenient point for measuring plate current is the plate load or plate decoupling resistor. Connect the negative lead from the meter to the plate and the positive lead to the "B" side of the resistor. Using Ohm's law the plate current is found instantly. The same method is used for checking screen current.

Occasionally it is desired to find the total current from the "B" supply. It is possible to unsolder either the transformer center tap or some other point in the d.c. path and connect the meter in series as an ammeter. A simpler method is to use the ohmmeter range to measure the d.c. resistance of the choke or whatever element is used in the filter network, and then measure the voltage across the choke.

To utilize d.c. troubleshooting to its fullest extent, the service technician must be familiar with the voltages and currents in every stage of the TV receiver. Table 2 shows the approximate voltages and currents found in each receiver section with most popular TV tubes. This table does not take the place of manufacturers' data but is meant to be used when the exact manufacturers' data is not on hand. Together with the material presented in this article, this table should make d.c. troubleshooting simple and efficient. —30—

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20 Watts. From	4 Ohms	to	50K Ohms.	Ea. .20
25 Watts. From	1 Ohm	to	100K Ohms.	Ea. .30
50 Watts. From	5 Ohms	to	100K Ohms.	Ea. .40
100 Watts. From	50 Ohms	to	100K Ohms.	Ea. .50

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.002	600	.24	.002	1200	.35	.005	2500	.55
.01	600	.26	.024	1500	.65	.002	2500	.45
.02	600	.28	.033	1500	.75	.004	2500	.50

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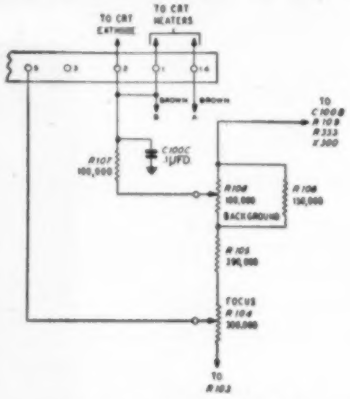
48-700

Poor or no background control.

The background control R_{108} (100,000-ohm pot) may fail because of transients or surges under certain operating conditions. When replacing this control, rewire the circuit as shown in the accompanying figure. (This applies only to sets prior to Production Run 6).



48-1000, 48-1001, 48-1050

Loss of a.g.c.

An extremely black picture and difficulty in synchronizing the picture is indicative of loss of a.g.c. This may be caused by a shorted or leaky condenser between the triode plate and the diode plate of the a.g.c. amplifier tube. This results in a positive voltage being placed on the a.g.c. bus to the grid of the r.f. and i.f. amplifiers. Replace this unit, if defective, with a .01 μfd., 600 v. condenser.

49-1002, 49-1040, 49-1075, 49-1076, 49-1240, 49-1275 & 49-1278

Loss of sync.

This may be due to some video signal being fed to the sync amplifier when the contrast control setting is at a maximum. To correct this, remove the sync take-off point from the video output stage to the video detector. Add a 10,000-ohm isolating resistor. This will prevent loading of the video detector output network.

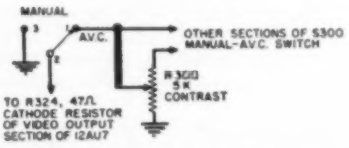
To effect the above changes, do the following:

1. Mount a single lug terminal strip near the video output tube (12AU7) socket.
2. Add a 10,000-ohm resistor between J_{301} and the insulated terminal of the above strip.
3. Remove C_{306} (.047 μfd. condenser) and the wire that connects it to pin 4 of the 7N7 sync preamplifier tube. Rewire C_{306} to pin 4 and the 10,000-ohm resistor added in step 2.
4. Dress the picture tube grid lead as far away as possible from C_{306} and the 10,000-ohm resistor.
5. Return the grid of the sync separator (second half of 7N7) to ground by rewiring the cold end of R_{316} (1 meg.) to the adjacent terminal.

Fine beat pattern in picture.

Video feedback from the video amplifier stages may cause this condition.

1. This may be eliminated by dressing the following condensers as close to the chassis as possible:
   a. Blocking condenser C_{316} (.047 μfd.) between the video detector (pin 7, 6AL5) and the video amplifier (pin 2, 12AU7).
   b. Blocking condenser C_{218} (.22 μfd.) between the first video amplifier plate (pin 1, 12AU7) and the second video amplifier grid (pin 7, 12AU7).
   c. Blocking condenser C_{321} (.047 μfd.) between the second video amplifier plate (pin 6, 12AU7) and the picture tube grid.
   d. The green lead feeding the picture tube grid should be dressed away from the chassis by a fish paper stand-off.
2. To further reduce the video feedback, it may be advisable to shield the wire connecting the contrast control to the a.v.c. "on-off" switch. The best method for doing this is as follows:
   a. Remove the ground connection to the contrast control. Accompanying diagram shows ckt. before changes.

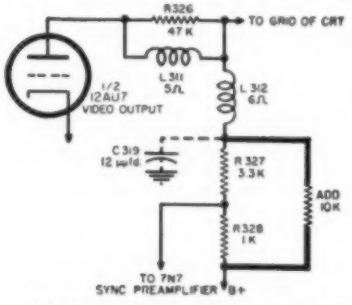

MANUAL
A.V.C.
OTHER SECTIONS OF S300 MANUAL-A.V.C. SWITCH
R320 2 K CONTRAST
TO R324, 47Ω CATHODE RESISTOR OF VIDEO OUTPUT SECTION OF 12AU7

   b. Rewire the ground connection of the brightness control (R_{321}, 100,000 ohm pot) directly to the ground ter-

minal of the terminal panel next to the volume control (R_{206}, 2 meg. pot).

c. Replace the wire connecting the contrast control and the a.v.c. "on-off" switch with an insulated shielded wire. Observe proper lead dress.
d. Connect the braid of the shielded wire to the original ground terminal of the contrast control, and the center conductor to the center terminal of the control.
e. Ground the braid of the shielded wire to the ground terminal to which C_{205} (.01 μfd.) condenser is grounded.
f. Connect the center conductor of the shielded wire to the proper terminal on the a.v.c. "on-off" switch.

Pictures with trailing whites or blacks.
This is probably due to phase distortion in the video amplifier because of excessive high video-frequency response. To improve this, remove C_{210}, the 12 μμfd. high-frequency compensating condenser in the video output plate circuit, and add a 10,000 ohm resistor in parallel with the two plate load resistors R_{227} (3300 ohms) and R_{228} (1000 ohms), as shown in the accompanying diagram.



49-1040, 49-1240, 49-1278 & 49-1280

Repeated fuse blowout.
The value of the protective fuse used in the first production models of these sets is ¼ amp. Under normal operating conditions, the current surge during the warm-up period may cause this fuse to blow. Replace this fuse with a ⅜ amp. unit, irrespective of the value of the fuse found in the receiver.

ALL 1949 MODELS

Hum in sound.
This may result from radiation by the vertical sweep generator, and may be identified by varying the vertical hold control and noting whether the pitch of the hum varies. To reduce this effect, do the following:

1. Chassis with 4-stage i.f. strip:
   a. Move the blue lead connected to pin 6 of the vertical discharge tube (½ 7F7) to the vacant terminal op-

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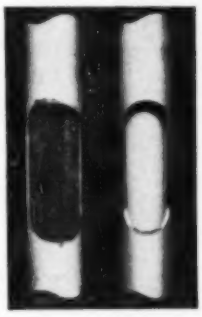
HERE'S INSIDE INFORMATION ON WHAT CORROSION DOES

Section of ordinary conduit tubing used for TV masts after 96 hours in a salt spray test (A.S.T.M. Designation B-117-49T) to accelerate corrosion. Extensive rust inside the mast has reduced strength—caused rusty water to drain onto the owner's home.



Section of PERMA-TUBE after 500 hours salt spray test shows no evidence of corrosion. Strength has been retained and the chance of rust streaks on owner's home are eliminated. Note sturdier wall thickness of Perma-tube sample.

FOR COMPLETE INFORMATION MAIL THIS COUPON TODAY

J&L STEEL

Jones & Laughlin Steel Corporation
493 Gateway Center
Pittsburgh 30, Pa.

Without charge, please send me: ☐ Name of nearest distributor
☐ Complete information on Perma-tube

Name
Company
Address

TUNG-SOL statistical quality control methods produce the industry's most reliable tubes for all uses.

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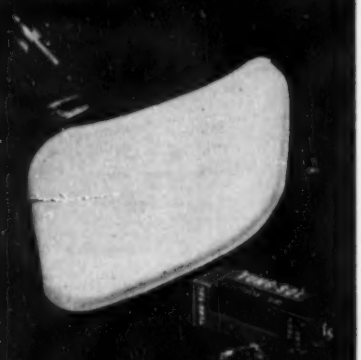
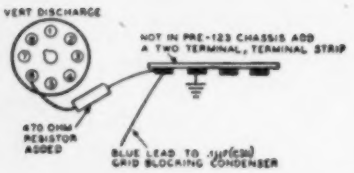
Newark 4, N. J.

Sales Offices: Atlanta, Chicago, Culver City (Los Angeles), Dallas, Denver, Detroit, Newark



TUNG-SOL
RADIO, TV TUBES, DIAL LAMPS


VERT DISCHARGE
NOT IN PRE-123 CHASSIS ADD A TWO TERMINAL, TERMINAL STRIP
470 OHM RESISTOR ADDED
BLUE LEAD TO (PIN 6) GRID BLOCKING CONDENSER

posite pin 4 of the tube. See accompanying diagram.

b. Connect a 470-ohm resistor from pin 6 to blue lead.

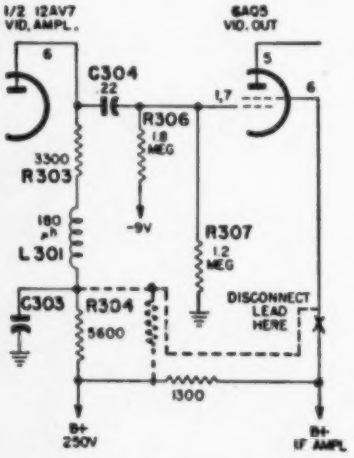
2. Chassis with 3-stage i.f. strip:
   a. Mount a 2-terminal mounting strip opposite pin 4 of the vertical discharge tube.
   b. Make changes in (1).

R.F. CHASSIS 33

Picture washout.

Picture washout occurs when the black parts of the picture turn grey if the contrast control is advanced to the maximum clockwise position. This may be caused by overloading of the video amplifier, and the fault is generally in the video output stage.

To correct this, provide a higher screen voltage for the 6AQ5 output tube to enable this tube to handle higher signal levels without overloading. This is accomplished by disconnecting the



screen lead from its supply and reconnecting it as shown (dashed) in the diagram. The added resistor is 12,000 ohms, 1 watt. An additional improvement results when R_{307} (1.2 meg.) is changed to 1.8 meg., and R_{306} (1.8 meg.) is changed to 1.2 meg. This increases the grid bias, and permits a higher input level.

R.F. CHASSIS 41 & 44

Poor sync in fringe areas.

To improve synchronization in fringe areas having a high noise level, make the following changes:

1. Replace R_{405} (180,000 ohms) with a 240,000 ohm resistor.
2. Remove condenser C_{402} (33 μfd.) from plate of noise gate to ground, and connect it in the second sync separator circuit

SPRING SALE
PRICES SLASHED

T.V. TUBES—ROCK BOTTOM PRICES
In lots of 6 each No. only

6BQ6 ..... 89c 6CB6 ..... 39c 6AQ5 ..... 38c
1B3GT ..... 89c 6AK5 ..... 69c 6CD6 ..... $1.05
12AX7 ..... 47c 6BQ6 ..... 57c 6S4 ..... 49c

Tube Special—Broken Keys—Electrically Perfect
12A6...29c; 4 for $1.00 12K8...49c; 7 for $3.00

Tube Sale—2-2A7-55-27-85-31-56. No Mixed Ass't. 6 of Any Type $2.25

Heavy Duty Shielded P.P. Input Trans. $1.00
H.D. Silver Contact Trans. Keys. 1.00
Bat Handle S.P.S.T. or D.P.S.T. Toggle Switch. 29c
Isolantite Octal Panel Clamp Sockets ..... 3c ea.
100 Assorted Resistors $1.95
1 Mfd., 1,000V Oil Filled Cond. 75c
3 Gang Var. Cond. 456 K.C. with Osc. Section. 2¾ in. Pulley on ⅜" Shaft. 49c
Westinghouse Kuprox Rectifier 0.64 Amp. 28 Volts. Reg. $11.00 ea. Special $1.95
BRAND NEW 10" PHONO RECORDS—Ass't. Jazz—Popular, Rhythm—Blues. Please specify. 12 for $1.70 or 24 for $3.00
Single Pole—10 Pos. 2 Gang Switch 29c
Grind your own Crystals. Pure Brazilian Quartz. Various sizes and thicknesses. ¼ lb. pkg. $1.00
4 Tube Dividal Chassis, 4½"x8½"x1½". 29c each
Signal Corps Phones—2 M. Ohms (8 M. Ohms Imp.) $1.25
2 Ft. Ext. Cord (and Plug) 49c

TOBE TUBULAR ELECTROLYTICS
20-20 MFD. 150 V...49c 30-30 MFD. 150 V...87c
40-40 MFD. 150 V...59c

Low-Loss Short Wave Lock Type Air Trimmer Variable Condensers
5 Pl.—20Mmfd. 14c
7 Pl.—25-30 Mmfd. .15c
8 Pl.—30-35 Mmfd. .16c
14 Pl.—56 Mmfd. 24c

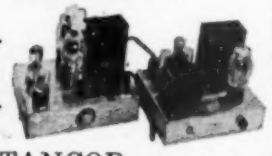
3 GANG T.R.F. VARIABLE CONDENSERS .0003565 Cen. 69c

D.P.D.T. TOGGLE SWITCH SLIDE 18c

1,000 OHM WIRE WOUND POTENTIOMETER 15c
30 HY-FILTER CHOKE SHIELDED ..... 3 for $1.25
PIEZO CRYSTAL HOLDERS..12 for $1.00—$6.00 per C
RCA Band Switches—
3 gang, 3 pos. 3 band.39c 6 gang, 4 pos. 4-5 band.49c
Trimmer-Padder Asst.—all isolantite—singles, dual-triples—100 asst. $2.25
ATTENTION: Prospectors, Explorers for Hidden Treasures! Construct a U.S. Army Type of Metallic Mine Detector Amplifier. Amplifier unit only (less tubes and batteries) with cables, headphone cord, and jack. Army wiring diagram. Type AN/PRS-1. ..... $1.95
Philco push button Rotary Switch Double Pole....35c
6 or 9 Gang Push Button Switch 49c
DRILLED CHASSIS FOR 5-6 tubes 5"x10"x1½"..25c
PHONE JACKS—OPEN & CLOSED AUTO. 15c
156-1 RATIO VERNIER DIALS—4 in., ⅜ in. Hub.35c
SALE—PHONO RECORD ALBUMS—12"—3 comp.—15c; 10"—3 comp.—15c; 4 comp.—20c; 12 comp.—69c
VULCAN HEAVY DUTY 100 WATT SOLDERING IRON. Built for U.S.N.—Brand New—Equip. sells for $8.50. ..... OUR PRICE $2.99

MINIMUM ORDER $3.00—NO C.O.D.
SHIPMENTS—PLEASE INCLUDE POSTAGE
NEWARK SURPLUS MATERIALS CO.
324 Plane Street, Dept. JE, NEWARK 1, N. J.

HI-FI WILLIAMSON TYPE AMPLIFIER KIT



Using STANCOR transformers. Easy-to-assemble amplifier kit. Comes with schematic and instruction sheet based on famous Williamson circuit. Frequency response ±1 db. from 20-50,000 Kc. at 8 watts. Intermodulation distortion is only 3% at 8 watts output. Total harmonic distortion at 1000 cycles is non-existent below 10 watt power level.

SPECIAL
Price Per Kit $44.95
Less Tubes

WITH CBS HYTRON TUBES | 2—GL807, 2—6SN7GT, 1—5U4G | TOTAL PRICE $52.75

IRISH PLASTIC RECORDING TAPE
BRAND NEW! NOT SURPLUS. This First Grade recording tape is ¼ in. wide. Frequency response: 50 to 8,000 cy. Plastic reel and box included with each.
600 FT. $1.35 1,200 FT. $2.10

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Los Angeles 46, Calif.

from plate to grid return (from pin 6 of 12AU7 to junction of R_{801}, 1.2 meg., and R_{805}, 270,000 ohms).

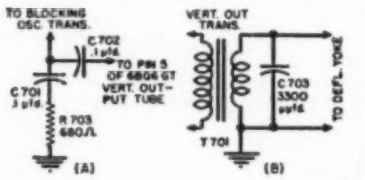
3. Change resistor R_{803} from 10,000 ohms to 4700 ohms. This will allow this cathode-follower circuit to function more efficiently with a greater number of 12AV7 tubes when replacement becomes necessary.

DEFLECTION CHASSIS D-1, D-1A, D-4 & D-4A

Vertical output transformer buzz.

This may be caused by excessive peak voltages applied to the vertical output transformer T_{701}. To reduce this effect, make the following changes:

1. Remove R_{703} (680 ohms) and ground the lower end of C_{701}



(.1 µfd.). See part (A) of the accompanying figure.

2. Connect R_{703} in parallel with condenser C_{703} (3300 µµfd.) at the deflection socket J_{800}. See part (B) of diagram. This change places R_{703} in the transformer secondary and reduces the peak voltages applied to the transformer. —30—

TV SERVICE BENCH REPORTS

By MILTON A. KENNEDY, JR.

CROSLEY TV MODEL 11-442MU

The symptom encountered was weak sound occurring only on strong local live telecasts. The reason was that the strong signal dropped the plate voltage on the 1st sound i.f. to around 20 volts, when it should have been 65 volts, according to the data. After numerous circuit checks, no defective circuit element could be found. To increase the plate voltage on this tube remove the plate load resistor, which is in the neighborhood of 18,000 ohms, and run the plate lead through a 30,000 to 40,000 ohm resistor to some other "B+" source in the set. This new "B+" source should give about 190 to 250 volts. It is generally inadvisable to make circuit changes in TV receivers, but this one has worked well.

MOTOROLA TV CHASSIS TS-236

The picture was compressed from the top to approximately the center of the screen. A resistor in the vertical linearity circuit was open. This resistor, 4800 to 8200 ohms, is connected from the high side of the control to ground.

MOTOROLA TV SETS

These sets sometimes exhibit a lack of width with nothing seemingly defective in the circuit. Connect a 35 to 150 µµfd. condenser from the plate to the cathode of the 6W4 damper tube. It gives excellent results. A 1000-volt rating is recommended for the condenser since this is necessary to withstand normal operating and surge voltages in the circuit.

—30—

ATR
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STANDARD and HEAVY DUTY
INVERTERS
For Inverting D. C. to A. C. ...Specially Designed for operating A. C. Radios, Television Sets, Amplifiers, Address Systems, and Radio Test Equipment from D. C. Voltages in Vehicles, Ships, Trains, Planes and in D. C. Districts.
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Quality Products Since 1931
SAINT PAUL 1, MINNESOTA—U. S. A.

CHANGE 6 OR 12 VOLT D.C. TO 110 VOLT A.C. 60 CYCLE
Just plug into Cigar Lighter on Dash.

Trav-Electric Super
Model 6-71160
60 cycle
60-75 Watts
$37.95 LIST

Size 4"x5"x6"

Operates
- Wire Recorders
- Amplifiers
- Soldering Iron
- Dictating Machines
- Turntables
- Small Electric Drill

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60 cycle
40-50 Watts
$24.95 LIST

Size 4"x5"x6"

Operates
- Curling Irons
- Radios
- Turntables
- Small Dictating Machines
- Test Equipment, etc.
- Portable Phonographs

Trav-Electric Senior
Model 6-1160
60 cycle
35-40 Watts
$15.95 LIST

Size 2½"x2½"x4½"

Operates
- Test Equipment
- Turntables
- Lights
- Short, Long Wave Radios
- Portable Phonographs
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Trav-Electric Midget
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10-15 Watts
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Size 2"x2"x3½"

Operates Test Equipment, All Electric Shavers

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4237 N. Lincoln Ave., Chicago 18, Ill., U. S. A.
Cable Address—*Harscheel*

Lie Detector
(*Continued from page 57*)

to a teen-age boy. In this list we included the name of a girl whom he secretly admired. When the girl's name was mentioned, the galvanometer light beam traveled around two walls of the room! We leave further suggestions for questioning to you and your imagination.

There is usually about a two-second delay before the meter gives an indication of any emotional activity. If the questioning becomes heated, the meter may continually climb off scale and need to be repeatedly brought back on scale by means of the balanced adjustment.

The amplifier, for test purposes, was built on a small metal panel. Rather than rebuild the circuit, the panel was mounted perpendicular to the chassis with small angle brackets.

Several tie points are needed on the amplifier chassis to secure the resistors and interconnecting wires. R_{11}, visible in the photograph, is a two-watt unit. We have replaced this with a five-watt wirewound unit. Ordinarily, 10% carbon resistors are used in the amplifier. For greater stability deposited carbon units are preferable.

The under chassis photo shows the placement of the remaining components for the power supply and resistance bridge. Again the resistors need not be precision. Ten per-cent units are as good as any since the bridge is brought into balance by the variable resistors. Notice that these controls are of the linear taper variety!

Since one side of the bridge is grounded, the electrodes place the subject at ground potential. This reduces any danger of hum pickup which might overload the amplifier. In general, the layout is not critical.

Some amplifier drift can be expected if the line voltage changes are appreciable. In actual practice no trouble has been experienced from this quarter, but checks with a variable voltage transformer show the situation could arise in some locations. If there is trouble of this sort, we recommend a *Sola* constant-voltage power supply transformer. —30—

NEW TV STATIONS ON THE AIR

(As of May 25, 1953)

The TV stations listed below are those which began commercial operation between April 5th and May 25th. To obtain a complete list of all new TV stations on the air, it is suggested that you add the list below to the list appearing on page 86 of the May issue of RADIO & TELEVISION NEWS.

STATE, CITY	STATION	CHANNEL	FREQUENCY RANGE (IN MC.)	VIDEO WAVELENGTH (IN FT.)	VIDEO POWER* (IN KW.)
California					
San Luis Obispo	KVEC-TV	6	82-88	11.8	19.8
Santa Barbara	KEYT-TV	3	60-66	16.06	50
Colorado					
Pueblo	KCSJ-TV	5	76-82	12.74	12
Florida					
Ft. Lauderdale	WFTL-TV	23	524-530	1.87	100
St. Petersburg	WSUN-TV	38	614-620	1.60	83
Illinois					
Belleville	WTVI	54	710-716	1.38	220
Indiana					
Lafayette	WFAM-TV	59	740-746	1.34	20
Muncie	WLBC-TV	49	680-686	1.44	16
Michigan					
Saginaw	WKNX-TV	57	728-734	1.35	19
Minnesota					
Duluth	WFTV	38	614-620	1.60	17
New Mexico					
Roswell	KSWS-TV	8	180-186	5.43	110
New York					
Elmira	WTVE	24	530-536	1.85	58
North Carolina					
Raleigh	WNAO-TV	28	554-560	1.77	280
North Dakota					
Fargo	WDAY-TV	6	82-88	11.8	70
Ohio					
Zanesville	WHIZ-TV	50	686-692	1.43	91
Pennsylvania					
Harrisburg	WHP-TV	55	716-722	1.37	240
South Carolina					
Charleston	WCSC-TV	5	76-82	12.74	100
Columbia	WCOS-TV	25	536-542	1.83	89
Texas					
Houston	KUHT†	8	180-186	5.43	30.2
Lubbock	KCBD-TV	11	198-204	4.93	92
Washington					
Bellingham	KVOS-TV	12	204-210	4.79	16

†Educational, U. of Houston
*From Station CP application.
The frequency of the video carrier = 1.25 + channel lower freq. limit.
Total number of television stations now on the air: 187 (37 of which are u.h.f.)

MAIL YOUR ORDER TODAY—OLSON WILL RUSH IT RIGHT AWAY!

ONLY WILCOX-GAY Recordio TAPE RECORDER with PREST-O-MATIC push-button keyboard gives MAXIMUM performance for LOWEST cost!

Choice of 2 Models

$99.50 EA.

STOCK NO. AMP-10 Records at 3¾" and 7½" per sec.

STOCK NO. AMP-17 Records at 1⅞" and 3¾" per sec.

This is the famous DeLuxe Wilcox-Gay Recorder that retails all over the country for $179.95. Naturally they are all brand new, in factory sealed cartons and Guaranteed 100% by Wilcox-Gay and Olson.

How can we sell this outstanding value for such an amazing low price? The answer is simple . . . our main purpose in this business is to offer the highest quality for lowest cost . . . and the Recordio is a perfect example.

Record those treasured "Family Highlights" . . . or your favorite music, broadcasts, friends or parties. Use it in your business for dictation, meetings, speeches, etc. Portable Recordio is also a valuable aid in Schools, Churches, and Clubs.

Remember . . . it's completely Automatic . . . the finger-tip controls are so simple even a child can operate it. And we're offering the finest Recorder we've ever featured at LESS than Dealer's Cost.

INSTANTANEOUS RECORDING OR PLAYBACK, 2-SPEEDS, RECORDS, PLAYS BACK, ERASES. LOOK AT THESE QUALITY-PACKED FEATURES: Five "Prest-o-matic" Controls allow instant choice of all operating functions . . . high speed forward and reverse, record, stop, and play-back. Handles up to 7" reels. Complete range of recording times:

RECORDING TIME ON 7" REELS USING BOTH CHANNELS

Stock No.	1⅞" Per Sec.	3¾" Per Sec.	7½" Per Sec.
AMP-10	.....	2 Hrs.	1 Hr.
AMP-17	4 Hrs.	2 Hrs.	.....

On 5" Reel Figure One-Half of Above Time

80-6000 CPS at 3.75" and 75-10,000 CPS at 7.5" per second.

Neon Indicator shows Normal and Overload levels. Full Range Variable Tone Control allows maximum brilliance to a deep, rich bass tone. Volume Control bass and treble compensated for best reproduction.

COMPLETE . . . READY TO OPERATE. Included: Weatherproof Controlled Reluctance Microphone. Radio . . . Phono . . . TV Input Jack permits recording from radio, phono or TV speaker voice coil by means of patch cord. External Speaker Jack for external speakers automatically disconnects internal 5" x 7" elliptical P.M. Speaker. 4 Tubes . . . 6SJ7, 6AQ5, 12AX7, 6x4 Rectifier. 7 ft. Cord. Handsome Removable Cover. Operating Instructions. Size 12" x 14" x 9". 23 lbs. complete. 110-120 Volt 60 Cycle AC. U.L. Approved.

TRUE HIGH-FIDELITY NEW LOW COST!

Revolutionary Audio-Tone High-Fidelity Loudspeaker

Stock No. S-201 Complete, Ready to Assemble $19.95

Olson worked shoulder to shoulder with electronic experts to develop the New Audio-Tone High-Fidelity Loudspeaker—our goal being to give you a powerful yet compact quality speaker system for true High-Fidelity sound reproduction at lowest possible cost. Audio-Tone incorporates the now famous principle of employing the corner of a room as an extended bass and high range reproducer.

Vibration and distortion-free Audio-Tone now makes it possible for you to enjoy the full tonal range and fine reception found only in the much more expensive space-consuming cabinet loudspeakers. You'll be thrilled by the full, rich, resonant tones you never knew existed when you attach the Audio-Tone to your present AM or FM Radios, Tuners, TV, or Record Player. Special waffle-type fibre-pad baffle traps and removes all the undesirable tones emitting from the back of the speakers.

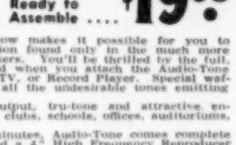
Audio-Tone's compact size, high power output, tru-tone and attractive enclosure also make it an ideal installation for clubs, schools, offices, auditoriums, factories, etc.

Easy to assemble, a boy can do it in 20 minutes. Audio-Tone comes complete with 6" x 9" Low Frequency Reproducer and a 4" High Frequency Reproducer or Tweeter—both with Alnico 5 Magnets. Marvon Leatherette Enclosure, Handsome Plasti-Weve Grille, Hook-up Wire, Cross-over Condenser, Mounting Hardware and Full Instructions. Corner Size—18" High, 20" Wide, 10" Deep. Shpg. wt. 11 lbs.

Sets a record! But Gently

3-SPEED GENERAL INSTRUMENT AUTOMATIC RECORD CHANGER WITH GENUINE ASTATIC "TURNOVER" CARTRIDGE

Changes All Sizes—7, 10, 12" All Speeds—33⅓, 45, 78 RPM



HI-FI DELUXE MODEL
Stock No. RA-113

This General Instrument Record Changer has turned out to be Olson's ALL TIME BEST SELLER. For Good Reasons, too! It performs like the Pace-Setter it is—the smoothest running changer on the market today. Records slide gently down the spindle—no chance of damaging those valuable records. Simple to operate—because it is precision-built by craftsmen who have had years of experience, thus insuring years of trouble-free performance.

Changer may be connected to any Radio, TV or Amplifier. Clever "touch-plate" allows you to reject a record at will. Genuine Astatic "Turnover" Cartridge is included at this fabulous low cost. Of course they're Brand New, in original factory-sealed cartons, and guaranteed 100% by Olson and the manufacturer.

Operates on 115 Volts AC, 60 Cycle. Base size 12" x 12½". 5¼" above plate and 3½" below.

Equipped with "Turnover" cartridge and dust needle. One side for 33⅓ and 45 RPM discs and the other side for 78 RPM discs. Both sides equipped with precious metal long-lasting tips. Regular retail price $52.50. Shpg. wt. 15 lbs.

Single, each $22.99
Ea., Lots of 3 ..... $21.99

PLASTIC BASE 600 FT. REEL

STOCK NO. X-275
Single, ea. $1.49
Lots of 10 $1.29 each

1200 FT. REEL

STOCK NO. X-249
Single, ea. $2.19
Lots of 10 $1.99 each

FULLY GUARANTEED BRAND NEW FIRST CLASS RECORDING TAPE OLSON'S TREMENDOUS BARGAIN

Get the buy of your life. Save up to 64% on high quality RECORDING TAPE. A large manufacturer had to sell his inventory and he unloaded the whole deal. Olson now offers you this high grade recording tape at prices which defy competition. Standard ¼" wide, 600 and 1200 ft. lengths. Frequency response 50 to 8,000 cy. Plastic Reel included with each. Shpg. wt. ea. 1 lb.

12" CO-AXIAL SPEAKER

$12.95

Stock No. S-168

Our new 1953 Model. Guaranteed to outperform any speaker in its price class. Equipped with two "high concentration" Alnico 5 magnets and a high frequency diffuser. The 12" section delivers the bass while the tuner 3" tweeter section delivers the treble tones. Together they give you "living tone." This speaker is unconditionally guaranteed to satisfy even the most critical user or Olson promises to refund your money. Only two wires to connect to any radio or amplifier. Voice coil impedance 8 ohms. Frequency response 30 to 17, 500 cps. Ship. wt. 10 lbs.

10 WATT HI-FI PUSH-PULL AMPLIFIER

$32.95 WITH TUBES

Stock No. RA-102

- Built-In Pre-Amplifier
- G-E Cartridge Input
- Treble and Bass Boost
- All-Aluminum Chassis
- Push-Pull Output
- Multiple Speaker Impedances

Bombshell Value! It's unbelievable. A full 10 watt Hi-Fi Amplifier, completely assembled and ready to play. Has built-in PRE-AMP for G. E. and similar G. E. magnetic pickups. 3 Inputs: 1 crystal phono, 1 magnetic phono, 1 radio, 1 mike. 4 Controls: 1 Bass, 1 Treble, 1 Volume, 1 Phono-radio Switch. Output Impedances: 4, 8, 16 ohms. Push-Pull Power output 17 watts.

Order this amplifier today and see what brilliant, realistic tone it will deliver. Supply is limited. Everyone in factory sealed carton. You couldn't buy the parts alone for this price. Remember this is a full size amplifier, transformer operated, not an AC-DC job. Frequency response 30 to 20,000 cps at less than ½ of 1% distortion. 5 Tubes: 1—6SL7, 1—6SC7, 2—6V6, 1—5Y3. Complete with tubes. Size 12" x 6¼" x 5½". Shpg. wt. 15 lbs. Can be used with any phono or speaker but you should take advantage of the Combination Deal offered below.

COMBINATION DEAL!

10 WATT HI-FI PUSH-PULL AMPLIFIER COMPLETE WITH 12" CO-AXIAL SPEAKER

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Both for Only $39.95 WITH TUBES

Completely wired. Not a kit.

This is the best matched Amplifier-Speaker Deal in America Today. You get the 10 Watt Hi-Fi Amplifier as described above PLUS the 12" Co-Axial Speaker—also as described above. Can be built into any cabinet or bookcase, giving you a complete amplifier system you will be proud to own and show to your friends. Look at our Amazing Low Price—and Order Today. Shpg. wt. 25 lbs.

GIANT AKRAD "LOADMASTER" CONDENSER KIT

STOCK NO. AS-20

$16.95

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2	.005	600	.25	.50
5	.01	600	.30	1.50
5	.02	600	.30	1.50
10	.05	600	.40	4.00
10	.1	600	.45	4.50
2	.005	1600	.60	1.20
2	.008	1600	.65	1.30
2	.01	1600	.65	1.30

27 Akrad "LOADMASTER" Electrolytic Condensers

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2	25	25	1.00	2.00
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5	40	150	1.35	6.75
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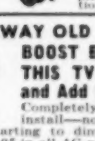

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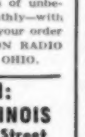

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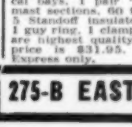

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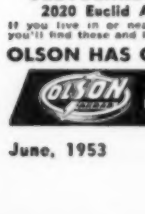

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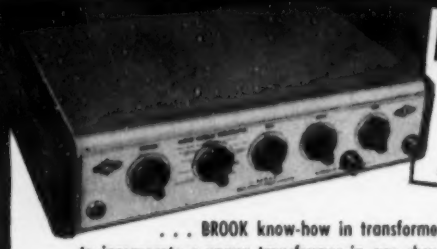

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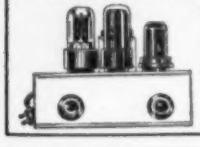

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1R5	.56	6BF5	.60	12AT7	.68
1S4	.61	6BF6	.39	12AU6	.43
1S5	.47	6BG6G	1.34	12AU7	.53
1T4	.56	6BH6	.87	12AV6	.37
1T5GT	.71	6BJ6	.48	12AV7	.70
1U4	.55	6BK7	.88	12AX7	.61
1U5	.46	6BQ6GT	.89	12BA6	.45
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2X2	1.30	6C4	.37	12BE6	.47
3Q4	.60	6CD6G	1.85	12BH7	.63
3Q5GT	.65	6J5GT	.40	12SA7GT	.52
3S4	.58	6J6	.62	12SK7GT	.50
3V4	.56	6K6GT	.41	12SL7GT	.61
5R4GY	.91	6L6GA	.80	12SN7GT	.54
5U4G	.40	6Q7GT	.50	12SQ7GT	.42
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5Y4G	.39	6SA7GT	.52	25BQ6GT	.89
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6AQ5	.54	6SH7GT	.47	25W4GT	.48
6AK5	.95	6SK7GT	.50	25Z6GT	.42
6AL5	.40	6SL7GT	.62	35B5	.48
6AQ5	.48	6SN7GT	.54	35C5	.48
6AR5	.38	6SQ7GT	.42	35L6GT	.47
6AS5	.50	6T8	.77	35Z5GT	.39
6AT6	.38	6U8	.78	50B5	.47
6AU6	.43	6V6GT	.46	50C5	.47
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Transistor Band Spotter

(*Continued from page 53*)

conventional Miller vacuum-tube oscillator, connecting the crystal (considered as a parallel-resonant circuit) between the base (grid) and ground, and tuning the collector (plate) with a parallel-resonant circuit. Perhaps a small feedback condenser might have to be connected between the collector and base to make it oscillate. It will not oscillate, though, because of the 1000 ohms between base and ground, which shorts the high parallel-resonant impedance of the crystal. Fortunately here the design engineer has recourse to the useful concept of duality[4], which suggests that grid voltages should be replaced by emitter (or base) currents and parallel-resonant circuits should be replaced by series-resonant circuits. This is easy here because the crystal can act as a series-resonant circuit, and therefore it is simply connected in series with the transistor base and the rest of the circuit. The maximum feedback is obtained at the series-resonant frequency, where the crystal impedance is minimum, and the base current is maximum.

The rest of the circuit could consist simply of a phase-reversing transformer, which could have a one-to-one ratio. Such a transformer was not readily available and, therefore, a collector choke L_1, condensers C_3 and C_4, and parallel circuit L_2C_1 were used to obtain a portion of the phase shift necessary for positive feedback. The voltage across C_4 is nearly sinusoidal because of the filtering effect of the tuned circuit $L_1C_3C_4$. The small condenser C_2 isolates the oscillator from load changes at Terminal 2. The voltage at the transistor base, which is coupled to Terminal 1 through a similar small condenser C_1, consists of a clipped sine wave which has strong harmonics throughout the high-frequency range.

Operation of the blocking oscillator is analogous to that of a vacuum-tube blocking oscillator, and can be understood if the following facts are restated: In a transistor, collector current flows when emitter current flows. In a "*p-n-p*" junction transistor, collector current flows when the emitter is positive with respect to the base or, since the grounded-emitter connection is used, collector current flows when the base is negative with respect to the emitter (providing, of course, that the collector is also negative with respect to the base).

Suppose now, that C_3 is charged so that the base is positive with respect to the emitter. The collector current will be cut off (or nearly so, if it is a good transistor), and C_3 will discharge through R_2 and R_4 until the base goes slightly negative with respect to the emitter. Emitter and collector current will then flow, and a regenerative action will take place through the block-

ing-oscillator transformer T_1, which is connected to produce a phase reversal. A heavy collector current flows, and the voltage across C_5 builds up very nearly equal to that of the supply voltage. At this point the charging current must decrease since the charge in C_5 has reached its maximum value. The transistor is soon cut off and the conditions existing at the start of the cycle have been restored. Since the charging cycle is much shorter than the discharging cycle, the voltage across C_5 is of saw-tooth form.

A sinusoidal synchronizing current is coupled to the emitter by C_3, and it is the purpose of one (out of 10) of the negative half-cycles of this current to initiate the regenerative charging action slightly in advance of its normal time, thus effecting synchronization.

The small condenser C_4 isolates the blocking oscillator from load changes at Terminal 3.

Construction

The details of parts layout and mounting are shown in the photographs. The box is 2½" by 3" by 4" deep. The depth could have been decreased by 1½ inches by using a hearing-aid type mercury cell in place of the flashlight cell and by removing the blocking-oscillator transformer from its case.

The transistors were mounted by means of bent soldering lugs. Although subminiature tube sockets could have been used, the transistors should last as long as the rest of the equipment, and therefore there is little reason for a change.

The crystal holder was wrapped in a piece of sponge-rubber to decrease the effects of shock, and mounted by means of a metal "strap."

Looking at the internal-view photograph, the crystal oscillator, using a CK721 transistor, is toward the far edge, although the top of the crystal holder is visible at the lower right. The blocking oscillator uses a CK722 in this unit. It will be noted that several leads are soldered together on the edge of one of the chokes, L_2 in the foreground. This is the junction of C_1, C_2, R_1, and the transistor base. It is *not* one of the connections of L_2 itself. It so happened that an extra hole in the choke base made a convenient tie point for these connections.

Adjustment

The transistors presently supplied are subject to wide variations in their characteristics and suitable allowances must be made in circuit adjustment. In setting up the crystal oscillator, the crystal and L_2 and C_4 should be disconnected, and the current through L_1 should be measured. If it is much less than the normal value of 100 microamperes a resistor, R_2 (shown dashed in Fig. 2) should be connected and adjusted to obtain 100 microamperes. If the current is much greater than 100 microamperes the transistor is defective. Next the crystal should be

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1R5	.59	6AG5	.64	6BE6	.49	6J6	.59	6X5GT	.43	25AV5GT	1.05
1S4	.76	6AG7	1.19	6BF5	.69	6K6GT	.54	12AT6	.47	25BQ6GT	1.08
1S5	.64	6AH6	.77	6BG6G	1.69	6L6GA	.86	12AT7	.69	25L6GT	.54
1T4	.64	6AK5	.88	6BH6	.59	6SA7GT	.61	12AU6	.54	25Z6GT	.49
1U4	.69	6AL5	.50	6BJ6	.49	6SC7	.76	12AU7	.59	35B5	.61
1U5	.61	6AQ5	.54	6BL7	.98	6SF5	.58	12AV7	.88	35C5	.61
1X2A	.69	6AQ6	.49	6BN6	.72	6SH7	.65	12BA6	.54	35L6GT	.61
3Q4	.75	6AR5	.69	6BQ6	.79	6SJ7	.54	12BE6	.58	35W4	.41
3Q5GT	.72	6AS5	.62	6BQ7	1.08	6SL7GT	.64	12BH7	.82	35Z5GT	.39
3S4	.49	6AT6	.46	6C4	.49	6SN7GT	.59	12SA7GT	.62	50B5	.61
3V4	.65	6AU6	.54	6C5	.57	6SQ7GT	.49	12SG7	.61	50C5	.61
5T4	1.31	6AV5GT	1.05	6CB6	.59	6SR7	.49	12SH7	.49	50L6GT	.59
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connected directly between the base and the emitter, a large variable condenser substituted for C_5, and C_6 adjusted to produce the maximum output as observed at Terminal 2. The frequency should then be checked, and if it is high an inductor, L_2, should be connected in series with the crystal and the frequency adjusted to zero beat with WWV. For this test the receiver antenna terminal should be connected to Terminal 1. A small condenser C_4 across L_2 will facilitate the initial adjustments while C_6 is used as the final (external) frequency trimmer.

If the frequency of the oscillator is low initially, a condenser should be connected in series with the crystal. A large variable condenser should be used for the initial adjustments.

Although a small *X*-cut bar was used in the oscillator described here, it has been found that 100-kc. loran-indicator crystals will work in the same circuit.

Adjustment of the blocking oscillator is comparatively simple, the best method requiring the connection of a receiver to Terminal 3. Switch on the beat-frequency oscillator and, if possible, tune the receiver to the low end of the broadcast band. Note the frequencies of two adjacent harmonics of the 100-kc. oscillator, and then adjust R_3 so that nine signals are observed between the 100-kc. points. To produce the best stability R_3 should be set to the middle of the range producing this result.

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2. *Law, Mueller, & Pankove: "A Developmental Germanium P-N-P Junction Transistor," Proceedings of the IRE, Nov. 1952.*
3. *Wallace & Pietenpol: "Some Circuit Properties and Applications of n-p-n Transistors," Proceedings of the IRE, July 1951.*
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—30—

NATIONAL ARRL MEET

THE Seventh Annual ARRL National Convention will be held at the Shamrock Hotel in Houston, Texas, July 9, 10, 11, and 12th.

This event, the only national amateur convention scheduled for 1953, is sponsored by the Houston Amateur Radio Club, Inc. An attendance of 2500 is anticipated.

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72 OHM (RG-59U) Coax-100 ft.	7.00

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Manufacturer's Surplus—Boxed—Fully Guaranteed

6SN7GT	88c	12AT6	60c
6AU6	65c	12BA6	69c
6SQ7	60c	12BE6	69c
6V6GT	60c	35Z5	54c
6S4	54c	50B5	69c
6AL5	59c	50E5	69c

We Carry a Full Line of CBS-Hytron and National Union Receiving and Picture Tubes at Regular Discounts.

SPECIAL PURPOSE TUBES

1616	$0.75	826	$ 1.25
1619	.40	836	5.00
1625	.40	8025	4.00
1626	.40	3E29	13.95

PHONO AMPLIFIER

A 3 tube phono amplifier complete with tubes and output transformer. Made especially for Boulevard. Uses 50L6—35Z5—12SQ7. A super buy. **$6.95 EA.**

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Minimum of 5 lbs. of usable, new radio—TV—electronic parts. Complete satisfaction guaranteed or 100% of purchase price refunded. **$1.99**

SENSATIONAL KIT BUYS

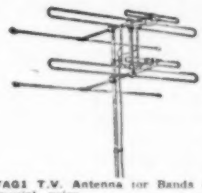
Paper tubular condenser kit of 100 new values from .0001 to .1 mfd. $15.00 value for only **$5.95**

50 assorted meas in popular values from 10 to 10,000 mmfd. $7.50 value for only **$2.95**

15 assorted single, double and triple section FP condensers worth $15.00 for only **$3.95**

25 assorted volume controls $10.00 value for just **$2.95**

15 assorted popular size 5 and 10 watt Resistors for **$2.95**



AMPHENOL Double Stacked TV ANTENNAS

Amphenol 114-332 double stacked T.V. antenna with 100 ft. of twin lead and 5 ft. mast. Regular $22.75 value for only **$18.95**

YAGI T.V. Antenna for Bands 4 and 5. Special price ..... ea. **$5.95**

Here's a real bargain in a quality all band in-line antenna complete with 5 ft. mast for only ..... ea. **$5.95**

BAT HANDLE TOGGLE SWITCHES

Bakelite insulation and silver-plated lug terminals on all units. SPST type rated at 3 amps. 250 volts. All others 3 amps. 125 volts. Underwriters' Laboratories Approved. Shank 15/32" dia., 15/32" long. With mounting nuts.

Stock No.	Mfrs. Type	Poles	NET EACH	Lots of 10 EACH
R125	20004-LH	SPST	51c	46c
R126	21350-HH	SPDT	86c	80c
R127	20002-CX	DPST	76c	69c
R128	20005-FR	DPDT	88c	79c

TV BARGAINS!

- Williams—300 ohm twin lead per 100 ft. **$1.50**
- Amphenol—300 ohm twin lead per 100 ft. **$2.00**
- 4 Strand—No. 20 galvanized guy wire. 1000 ft. **$5.95**
- 6 Strand—No. 20 galvanized guy wire. 1000 ft. **$7.95**
- H.V. Anode Connectors with 10½" Lead. ea. **20c**
- Full Moon PIC Tube Socket—15" Leads. ea. **20c**
- 1B3 Socket on Ceramic Pillar Insulator. 10 for **$1.75**
- 7 Pin Miniature Ceramic Socket w/Shield Base ..... 10 for **$1.75**
- Bogen BB-1 2 Tube Boosters ea. **$14.95**
- 70° Deflection Yokes—Unwired. ea. **$1.99**

Double Ion Traps $0.25

500 MMFD—10,000 Volt T.V. Bypass ..... .39

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All 115 Volts 60 Cycle Primaries

No. R-624—T.V. Power—H.V. 720 V.C.T. @ 265 M.A. with Taps @ 350 V.C.T. 6.3 Volts @ 12.3 AMPS and 6.3 Volts @ 1.2 AMPS 5 Volts @ 3 AMPS. Double half shell horizontal mtg. Mtg. centers 3" x 3⅜" ..... ea. **$6.95**

No. RS96—Delivers 200 V.D.C. @ 70 MA. And 6.3 V @ 1.2 AMP. Insulated for 3000 Volts. Vertical double half shell mtg. 2" mtg. centers ea. **$1.95**

PM SPEAKERS

6"x9" Oval PM Auto Speaker 3.2 ohm voice coil. 6 to 8 watts output	$2.95
6" PM Speaker 3.2 ohm voice coil. 6 to 8 watts output	2.39
5" PM Speaker. 3.2 ohm voice coil. 6 to 8 watts output	1.59
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90 ohm field. Manufactured by Rola. Terrific value at $2.95

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Secondary 2500 volts at 1.6 MA 7500 volts insulation. Open frame mounting. Mounting centers 3⅝".

Stock No. T-446

Price each $1.49

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WS-100—Single Heat—100 Watt	$11.95
WS-200—Single Heat—200 Watt	12.95
WD-135—Dual Heat—100/135 Watt	13.95
WD-250—Dual Heat—200/250 Watt	14.95

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KIT PRICE $59.50 EA.

WIRED and TESTED $89.50

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2 Watt P.P. Audio • Amplified AVC • Voltage Regulated Oscillator Supply • Noise Limiter • Beat Oscillator • Air Tuned R.F. Trimmers • 2 Stage Permeability Tuned 455 KC I.F. Plus Crystal Filter • Phono Jack—Built-in Standby Relay • Operates on 105 to 125 Volts AC or DC Power Source • Frequency Range 200 KC to 400 KC and 490 KC to 19 MC in Six Bands • 40:1 Geared Ratio Dial Drive • 11 Tubes Plus Selenium Rectifier • 6SG7 RF AMP. • 6SB7Y Mixer • 2-6SG7 I.F. • 6H6 2nd Det & N. L. • 6SF7 AVC AMP. • 6SL7 BFO & 1st Audio • 6SL7 Phase Inverter • P.P. 2SL6GT Audio • VR-75 Voltage Regulator • Full Vision Calibrated Dial • Cabinet 19½" long x 10½" high x 12½" deep • Finished in fine grain black wrinkle • Front panel silk screened to identify each control • Shipping weight 45 lbs. • Shipped Express Only.

FRONT PANEL CONTROLS

Tuning • R.F Gain • Audio Gain • BFO-AVC Switch • BFO Pitch • Power On-Off • Stand-by • Noise Limiter On-Off and Control • Antenna Trimmer • Crystal Filter On-Off • Crystal Phasing • Selectivity • Band Change Switch • Calibrated Dial Face.

COMPLETE KIT

This kit is complete with every part necessary to assemble into a finished receiver, including tubes and cabinet. Chassis is punched and marked. Mount the parts, wire it, align it and you have a fine receiver of commercial appearance, that can't be beat for 3 or 4 times the price. Parts layout, schematic diagram and alignment instructions are supplied.

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V-M MODEL 950 RECORD CHANGER **$29.95**

AUTO VIBRATORS

6 Volt 4 prong Universal type. Fits Motorola, Chevrolet & Chrysler **$1.39**

F. P. CONDENSERS

8 MFD 500 volts. Manufactured for Magnavox. 10 for **$3.00**

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Mallory 561C 5 Prong 24 Volt Vibrators	49c
Ohmite 500 ohm 25 Watt Resistor	25c
Single contact female cable type mike connectors	25c

COPPER OXIDE RECTIFIERS

Bradley Labs (CX3E Series) Dual Bridge Rectifiers. Current and Temperature Characteristics Balanced to Better than 1% from —40 °C to 70°C. 10.5 Volts Input. Max. D.C. Center Leg Current 15 M.A. Used as Balanced Modulators and Bridges. Hermetically Sealed **$2.50**

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HERE'S A TIP!

THE AMAZING NEW

RCP

MODEL 706A

"WIDE RANGE"

SIGNAL GENERATOR

IS IN A CLASS WITH SIGNAL GENERATORS SELLING FROM $90.00 TO $125.00

BUT...

YOUR COST IS ONLY

$67.50 NET

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COMPARE IT YOURSELF!

This new signal generator is the finest performer in its class. For equivalent performance the model 706A should be compared only with other signal generators selling from $90 to $125. It provides continuous coverage from 150 KC to 220 MC in 8 ranges. Six FUNDAMENTAL ranges cover up through 55 Megacycles.

ACCURACY: within 1% of calibration adjustment.

STABILITY: and constancy of calibration is assured by special electron-coupled circuit design, permeability adjusted coils and air trimmer capacitators.

MODULATION: 400 cycle sine wave audio oscillator with modulation continuously variable from 0% to 80%. Above 80% has no practical application. At this point tremendous distortion occurs in all signal generators. Unmodulated signal is available if desired.

SHIELDING: Thorough shielding of all critical circuits and components either individually or in compartment or both. This includes oscillator tube, coil assembly, attenuator, switching circuit. Transformer is electronically shielded.

ATTENUATION: Ladder type step attenuator consisting of a multiplier and fine attenuator control.

AUDIO OSCILLATOR: 400 cycles at 50 ohms output impedance is available for external use —terminals on panel.

Eight scales are clearly calibrated—continuous reading from 150 kilocycles to 220 megacycles. Planetary drive gives vernier tuning with no backlash. Tube complement—6BA6, 6SJ7, 6X4.

A high quality instrument in performance, construction and appearance. Size 15"x9"x7". Wt. 14 lbs. Complete with leads, ready for operation on 105-130 volts, 60 cycles.

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Write for the new 1953 RCP catalog to Dept. RN-6.

RADIO CITY PRODUCTS CO., INC.

152 West 25th Street — RCP — New York 1, N. Y.

International Short-Wave

(*Continued from page 69*)

Jose, has been on 6.755A lately, heard as *early* as 0900 and goes *past* 2100. *Radio Excelsior*, 6.510V, San Jose, *opens* 0700. (Stark, Texas)

Cuba—COBC, 9.363A, noted with strong, clear signal 2200; all-Spanish. (Hornstein, Mich.) COCQ, 9.670A, Havana, listed 5 kw., noted around 2100; has commercials. (Gaylord, Washington State) *Radio Salas*, 9.040A, noted 1910, good level. (Hyson, Md.)

Czechoslovakia—Prague, 9.504, noted with news 1400. (Pearce, England) Heard to North America on 9.550 at 1930-2000, 2300-2330. (Maynard, Ky.)

Ecuador—Officials of HCJB, Quito, airmail me that progress in the move of the transmitting facilities to Pifo has been slowed down due to floods in that area which washed out the railroad in several places; as soon as the move is made, HCJB should have a much improved signal over its new antennas. *Watch for announcements over the air; reception reports when change is announced will be welcomed.*

In verifying, HCAC, "La Voz de la Democracia," Quito, listed current channel as 6.060; heard recently on 6.070AV, once on 6.072, *after* 1800. (Mercier, France) *Radio Nacional de El Condor*, Guayaquil, listed 6.130, was noted recently on *measured* 6.1216 from 2335 to 0035 sign-off, good signal. (Rastorfer, N. Y.)

Egypt—Cairo, 11.815, noted closing 1600 in *English*. (Saylor, Va.)

Cairo's *new* 100 kw. transmitter on 9.752A is heard in Australia from opening 0100 to 0230A fade-out. (Radio Australia) Heard on this channel in Arabic for Middle East 1100A-1420A. (Bellington, N. Y., others)

El Salvador—YSS, 9.555, San Salvador, noted closing 2300. (Ferguson, N. C.) Heard on 6.010A to 2105. (Patterson, Ga.)

England — BBC's North American Service is heard on 15.31, 1000-1215, 1300-1415; 11.93, 1415-1545; 9.825, 1545-2115; 6.195, 17000-2200, and 6.125, 2300-0115. (Woodson, N. Y.)

Ethiopia — Addis Ababa, 15.047AV, noted in *English* 1330-1430. (Littlefield, Mass., others) Should have a *new* 15 kw. transmitter on the air soon. (*Radio Amateur*, London) A request has been made for channels in each band.

Finland—Helsinki, 15.190, noted with news 1430; in French 1445. (Littlefield, Mass.) OIX7, 6.120, heard in Sweden 1030-1138. (Hanel)

France—Paris, 11.9555A, noted in French 1445-1500, fair level. (Brown, Colo.)

French Equatorial Africa—Brazzaville, 11.970, noted with news 1545. (Boepple, Ohio)

French Guiana — Cayenne verified for Bellington, N. Y., with attractive color photo card; schedule is *now* 1730-1830 on 6.199, 350 watts in French.

French West Africa—Dakar, 4.955A, noted with news in French 0300; runs 0130-0330. (Saylor, Va.) The 9.560 channel noted to 1720V closedown. (Washington, N. J.)

Germany — Overseas Service over NWDR, 7.29, Hamburg, noted 1730 in German and *English; asked for reception reports.* (Pearce, England) RIAS, 6.006, Berlin, noted in Sweden 0500-0700. (Hanel)

Greece—Current schedule of *Radio Athens* is 2200-2300, 9.607; 1115-1130, 11.718; 1230-1600, 7.300; 1630-1800, 9.607; 1730-1900, 7.300. A *new* outlet of the Central Forces Radio Station, 7.420, Athens, has been heard *testing* to 1705 sign-off. (Radio Sweden)

Guatemala—TGNA lists channels of 5.9525, 9.668, 11.850. (Parsons, Pa.) TGWB, 6.180, noted 1930-2000; TG2, 6.62, *Radio Morse*, heard 1915-1930. (French, Mass.)

Haiti—4VEH, Cap Haitien, is now using 9.685 daily (*except Thur. when is silent*) 0600-0900; additional broadcast Sun. 1630-2130 is now on 9.713A.

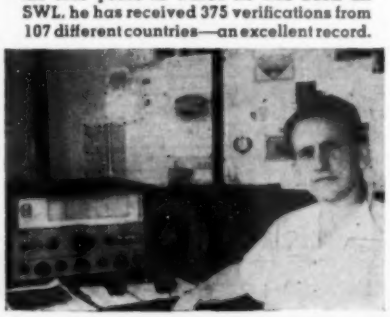
4VRW noted *varying* around 10.001-9.901; heard 1235A in French. (Corson, Iowa) *Radio Haiti* noted on 5.835A in French usually, but sometimes has English 2130. (Dexter, Iowa)

Honduras—Radio Progresso de Honduras, 6.184, identifies 1835; at times has heavy QRM. (Stark, Texas)

India—AIR now radiates to the United Kingdom-Europe 0230-0330 on 17.740, 15.380. (Radio Australia) Noted 0830-0945 in *English* to Southeast Asia parallel on 15.380, 11.850. (Washington, N. J., others)

Indo-China (Vietnam)—Radio France-Asie, 15.420, Saigon, noted closing down 0945. (Bishop, Ohio) With news 0500. (Sanderson, Australia) *Wants reports on this outlet* to Box 412, Saigon. (*N. Z. DX Times*) Heard now on 9.745A to Europe in French and *English* 1030-1130; *English* last half hour. (Pearce, Catch, England) *"Voice of Vietnam"* is good level in *English* 0930-1000 closedown on 9.62, 7.288. (Riggs, Calif., others) Hanoi, 7.405, heard 0715 with French news, music; fair level. (Sanderson, Australia)

Peter Ridgeway, Consort Mine, Noordkaap, E. Transvaal, South Africa, one of the world's leading DX-ers and a regular contributor to the ISW Department, uses a G.E.C. Brt. 400 communications receiver and a Marconi frequency standard. His antennas consist of seven arrays—four dipoles, two single-wires, and an inverted "V"—beamed to most parts of the world. In the four years in which he has been an SWL, he has received 375 verifications from 107 different countries—an excellent record.



Iraq—Baghdad, 6.135, noted 1415-1500 closedown with *English* session, "*Date With Baghdad;*" announces 11.724 as parallel. (Pearce, England)

Italy—Rome noted in *English* to Western North America 2145-2200 closedown on 9.57; announces 15.4, 11.9, 11.81, 9.71 in parallel. (Mesard, D. C.)

Japan—JKL, 9.603, noted 2120, fair in Ohio. (Arp)

Radio Japan, 7.180, noted 0600 with news, parallel 9.675; JKM, 4.940, noted 0510 with news and *English* lesson. (Sanderson, Australia) Now heard to Western North America over 11.705 (best) and 15.135 at 0000-0100. (Gay, Calif.) *Radio Japan* hopes to *extend* broadcasts later this year to Europe (French, German) and to Brazil. (*WRH*)

Kenya Colony—Nairobi, 4.855, takes BBC news relay 1300. (Pearce, England) Good level in Australia 1430. (Sanderson) FBS, 7.265, Nairobi, signs off 1500 but signal is erratic. (*N. Z. DX Times*)

Kuwait—"Huna Kuwait," 5.000, noted in Arabic 1330. (Pearce, Catch, England)

Liberia—ELBC, now 6.022A, Monrovia, is scheduled 1045-1845. (ISWC, London) Heard one Sun. until *after* 2000. (Saylor, Va.)

Luxembourg—Radio Luxembourg will shortly have a *new* 50 kw. transmitter in operation. (WRH)

Malaya—BFEBS, Singapore, noted on 11.955 at 0945 with BBC relay. (Pearce, England) On 7.120 around 0630 with native program, *English* announcements. ((Saylor, Va., others) *Radio Malaya*, noted in *English* 0945, good level. (Riggs, Calif.) Over 6.135 at 0600, fair level in N. J. (Washington) Kuala Lumpur, 6.025, has BBC news relay 0600. (Riggle, Ohio)

Mexico—Despite persistent overseas reports that the Mexican on 15.205A is an outlet of "*La Voz de Mexico*" (XEXE), it really is—and always has been—XESC (relaying m.w. XEMC) and its slogan sounds like "*Heraldos de la Tela de Junco.*" Announcements do *not* indicate any affiliation with "*La Voz de Mexico.*" (Stark, Texas, others) XEUW, 6.020, Vera Cruz, noted to 0042 recently. (Patterson, Ga.)

Monaco—Calls of *Radio Monte Carlo* are 3AM3, 6.035; 3AM4, 7.349. (*WRH*)

Mozambique—Portuguese outlet, 4.870, noted 1200 with chimes, closing 1514 with "A Portuguesa." (Pearce, England)

Lourenco Marques good lately in *English* session weekdays 2300-0030 on 9.766A. (Riggs, Calif.; Norman, N. C., others) Sundays at 0000-0100, fair level. (Balbi, Calif.) Noted parallel over CR7BU, 4.916, and on 3.490 (has QRM). (Washington, N. J.)

New Zealand—Revised schedules are to Australia 1300-1645, ZL7, 6.080; 1700-0045, ZL3, 11.780; 0100-0545, ZL7, 6.080. To Pacific Islands 1300-1645, ZL8, 9.62; 1700-0045, ZL9, 11.810; 0100-0545, ZL8, 9.620; closedown is 0545 weekdays, 0620 Sat., 0500 Sun.

Nicaragua—*Radio Sport*, 7.850A, is strong with Spanish 1800-2200. (Dexter, Iowa)

Nigeria—*Radio Nigeria*, Lagos, noted on 4.800A to 1500 closedown; BBC news relay 1300. (Pearce, Catch, England)

Outer Mongolia—Ulan-Bator is now heard on 6.328A from around 0400 to closedown 1000. (Japanese Short Wave Club)

Pakistan—*Radio Pakistan* has news 2130 over 15.335, 11.845. (Radio Australia) Noted with news 1015 over 9.484, 11.885. (Pearce, England) Heard on 11.885 with Home Service 1915, on 17.750 at 2315; 11.674 noted with news 0645; 15.335 has news 1930; noted parallel 1430-1600 over 6.235, 7.010.

Panama—HO50, 5.996, noted in Australia 0645 with Spanish news, music. (Sanderson)

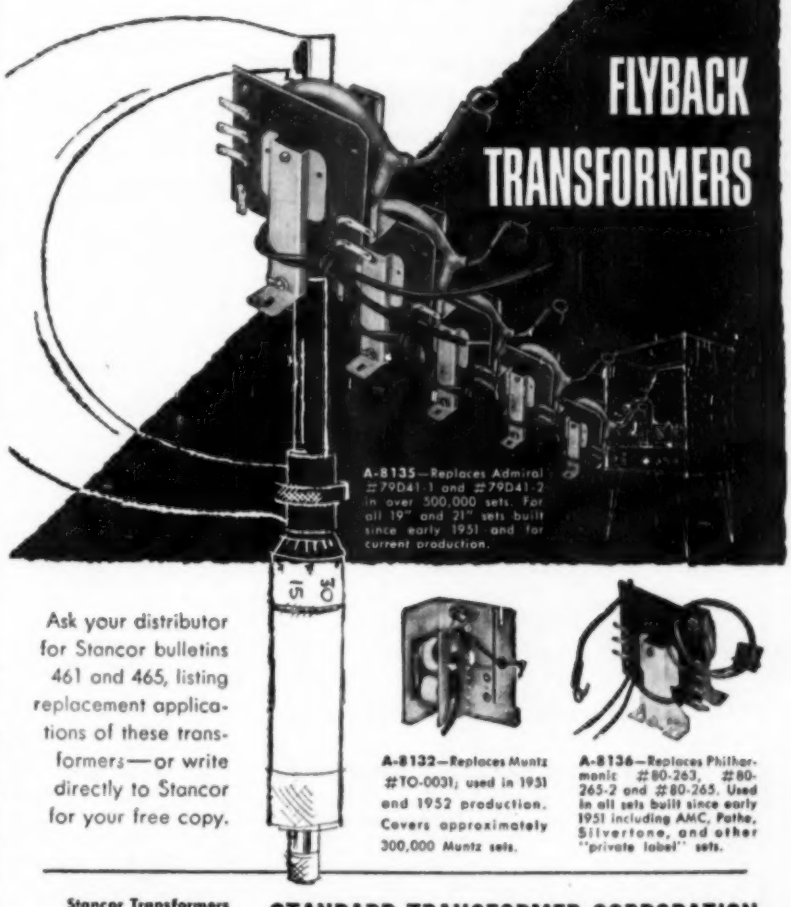
Peru—OAX6E, *Radio Continental*, Arequipa, noted back on 6.336A from 6.305; news in Spanish 2015; weak, CWYRM. (Mercier, France) OAX4X, 15.105, Lima *Radio El Sol*, is fair around 1645. (Niblack, Ind.)

Philippines—DZH3, 9.500, *Radio Philippines*, now uses 1 kw., 1600-1000. (ISWL, England) *Radio Free Asia* relay over DZ15, 11.940, Manila, is strong in Britain with news 0950, off 1014A. (Pearce) DZH9, 11.855, Manila, noted recently with special program (*English*) at 1000 to USA. (Pearce, England; Riggs, Calif., others)

Portugal—*Radio Nacional*, Lisbon,

STANCOR *Exact* REPLACEMENT

FLYBACK TRANSFORMERS



A-8135—Replaces Admiral #79D41-1 and #79D41-2 in over 500,000 sets. For all 19" and 21" sets built since early 1951 and for current production.

Ask your distributor for Stancor bulletins 461 and 465, listing replacement applications of these transformers—or write directly to Stancor for your free copy.

A-8132—Replaces Muntz #TO-0031; used in 1951 and 1952 production. Covers approximately 300,000 Muntz sets.

A-8136—Replaces Philharmonic #80-263, #80-265-2 and #80-265. Used in all sets built since early 1951 including AMC, Pathe, Silvertone, and other "private label" sets.

Stancor Transformers are listed in Howard W. Sams' Photofact Folders, John W. Rider's Tek-Files, and the Howard Company's Counterfacts.

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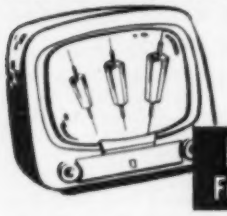

MIXER DIODES
For U.H.F. — TV Tuners

The taper of the diode case allows polarity identification at a glance or at a touch thus speeding up assembly and reducing the possibility of error in connecting the diode into the circuit.

Featuring polarity at a glance!

current flow ↑

1N72 Germanium	Noise figure as a mixer better than 15DB @ 750 MC with 43.5 MC-IF circuit having a noise bandwidth of 3 MC and a noise figure of 4 DB.
1N82 Silicon	Noise figure as a mixer better than 12DB @ 750 MC with 43.5 MC-IF circuit having a noise bandwidth of 3 MC and a noise figure of 4 DB.
1N110 Germanium	Noise figure as a mixer better than 12DB @ 750 MC with 43.5 MC-IF circuit having a noise bandwidth of 3 MC and a noise figure of 4 DB.

Radio Receptor Co. is one of the major producers of Standard Germanium Diodes, Germanium Transistors and Seletron Selenium Rectifiers for radio, TV and other electronic circuits. Write for information!

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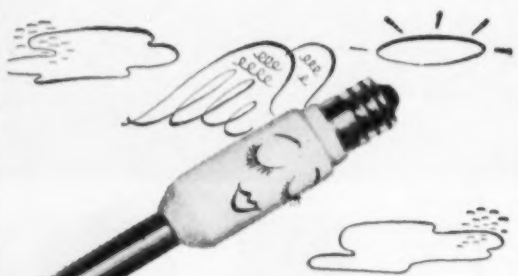

For a Heavenly Soldering Job, Insist on

Ungar's little Angels

Need we say more?

Write for Catalog RN-6

Ungar ELECTRIC TOOLS, INC., Box 312, Venice, Calif.

has been *asking for reports* on its North American frequencies of 5.976, 6.373, 9.746 at 1900-2100. (Boepple, Ohio)

Portuguese Guinea—CQM, 5.838, Bissau, noted 1650 with news in Portuguese. (de Mesquita e Sousa, Portugal)

Portuguese India—Radio Goa, 9.610, often carries "Bringing Christ to the Nations" (*English*) 1030. (Svensson, Sweden) Lists transmitters in the 31-, 49-, and 85-m. bands (probably 9.610, 6.025, 3.425), daily 2030-1130.

Reunion—Lists channels of 4.820, 7.170; heard on 4.820 at 0900-1310 (to 1345 Wed., Sat.) (Ridgeway, South Africa)

Roumania—Bucharest, 9.254, noted 1600-1645, poor level in Pa. (Black)

Saudi-Arabia—Djeddah noted around 2250 in Arabic over 6.102A parallel 7.200A. (Washington, N. J.)

South Africa—SABC, Johannesburg, noted closing 1130 on 11.937; reopening 1145 on 9.595A. (Pearce, England) Heard closing on 9.595A channel 1505. (Bellington, N. Y.) Heard in Britain on 4.895 from 1430. (URDXC)

South Korea—HLKA, 7.935A, Pusan, noted opening 0257, weak. (Gay, Calif.) HLKB, 9.555, Seoul, is scheduled 2130-0030, 0500-0900, 1600-1830. (ISWC, London) Noted by Sanderson, Australia, 0400 with Korean news, then Western music.

Spain—Radio Merida is now near 7.140 to 1800 closedown. (Pearce, England) Malaga, 6.979, good level 1335. (Catch, England) Madrid, 15.625, closes 1155 with anthem. (NNRC)

Syria—Damascus, 17.865, noted in *English* 1000-1045 to India-Pakistan. (Svensson, Sweden)

Switzerland—Berne, 9.655, noted with *English* for Western Europe 1345-1430; in Italian 1430. (Morrison, R. I.) Heard at good level on 6.165 to North America 2030-2115 and later. (Carroll, Me.)

Taiwan—BED6, 11.735, Taipeh, heard 2315 with news; BED32, 9.778A, noted 0500 with Western music, Chinese news; BED7, 7.130A, heard 0700 with Western music; BED26, 10.080, noted 1745, fair level in Chinese news, music. (Sanderson, Australia)

Tangier—Although *Radio International*, 6.110, is now using its *new* 50 kw. transmitter, signals are still badly QRM'd and *detailed reports are requested* to 34, Rue Goya, Tanger. QSL's will be accompanied by photo of new transmitter. (*Radio Amateur*, London)

Thailand—Bangkok, 11.910, noted with news 0500, on 6.240 with news 0615. (Sanderson, Australia) Heard over 7.105 at 0643, weak, native. (Ballou, Calif.)

Trinidad—Radio Trinidad, 9.625, noted with news 0700, BBC news 0800. (Saylor, Harold, Wisc., others)

Turkey—Ankara, 17.825, noted closing *English* for Far East 0915; opens 0830. (Pearce, England) TAS, 7.285, heard closing *English* 1645. (Harris, Mass.) Teknik University, Istanbul, 7.030, is good strength in Britain 1315-1500. (*Short Wave Listener*, England)

Uruguay—CXA19, 11.835, Montevideo, fair around 1700.

USI (Indonesia)—"*Voice of Indonesia*," 9.710, Djakarta, noted 0930-1030 in *English* to Southeast Asia; announces 4.910 parallel; heard over 11.770 at 1400-1500 to Europe, New Zealand; news 1430. (Pearce, England) With news 0615. (Sanderson, Australia) Makassar, *measured* 9.550, noted 0520, fair level, swishing QRN. (Ballou, Calif.)

USSR—Khabarovsk, 5.940, noted 0420, fair level, nice music; Alma Ata, 9.380, heard 0820, fair. Moscow noted opening to North America in *English* 1820 on 7.24. (Bullock, Duddy, Ind.)

Venezuela—Radio Rumbos, 4.970, Caracas, fair with news 1845. (Maynard, Ky., Richmond, N. Y., others) YVMS, 4.850, Barquisimeto, noted 2109-2130; CWQRM. YVKF, 4.880, heard 2350-0012. (Patterson, Ga.)

Yugoslavia—Radio Yugoslavia, Box 97, Belgrade, *tested* recently to the Americas 2030-2130 on channels of 6.100, 9.505, 7.200, 11.735; by this time probably will have settled down on one or more of these outlets. (Bellington, N. Y., others)

* * *

Press Time Flashes

Myron Smith, N. Y., reports a station announcing as "*Radio Germany*," broadcasting from Berlin, at 1300 with *English* on about 9.800.

VLT, Port Moresby, British New Guinea, by this time will have vacated 9.520 and 7.280 in favor of 6.130; schedule is VLT6, 6.130, Sat. to Wed., 1545-1745; Thur. 1545-1730; Fri. 1645-2000; Sun.-Thur. 2100-2245, 0100-0745; Fri. 2100-0800; Sat. 2100-2300, 0100-0700.

Radio Peking, China, lists *English* for 1730-1800, 6.100, 7.500, 9.040 10.260, 11.690, 15.060, 15.170; 0400-0430, 6.100, 10.260, 11.690, 5.060; 0830-0900, 11.690, 15.060. (Boepple, Ohio)

TGWA, Guatemala, now has "The Belize Program" (*English*) *one hour earlier*—1800-1900 on 9.760 on Mon., Wed., Fri. *only;* TGNA is now heard to 2200 in Spanish on 5.9525; 2200-2300 (Sun. to 2330) uses 5.9525 and 9.668 for *English* session. (West, Va.)

The French-speaking station on 9.430A at 1745-2000 appears to be "Ici Basse Terre, Radiodiffusion Francaise," Guadeloupe; has much CWQRM and some QRM from Brazzaville on 9.440. Frequency varies around *measured* 9.4353. (Rastorfer, N. Y.; Niblack, Ind.; Washington, N. J., others)

Suva, Fiji Islands, noted back on 5.995 (*varies*), closing 0500 with "God Save the Queen;" relays ABC news from Australia 0400. (Saylor, Va., Rosenauer, Calif.)

A *new* Costa Rican has been heard on 6.008 announcing "Emisoras de Radio Cristal en San Jose," heard 2030-2200 at good strength; call seems TIHV, m.w., and TIHVC, s.w.; commercials. ZPA3, *Radio Teleco en Asuncion*, 11.853A, Paraguay, noted opening 1700 with news in Spanish; on Tue. has religious broadcast 1745-1800. 4VWA, *Radio Citadelle*, Cap Haitien, Haiti, is heard in France as early as 1700 on 6.301; announces "Ici Radio Citadelle, Poste 4VWA au Cap Haitien, capitale touristique de la Republique d'Haiti, Grandes Antilles;" news in French 1800. A *new* Haitian is 4VGF, *Radio Independence*, Gonaives, a seaport and chief town of Northwest Province; uses 6.340, heard around 1850-2015 closedown; news in French 1900. Haiti is to commemorate the 150th anniversary of its national independence (1804) next year—which event occurred in Gonaives.

Peking—China, or relay thereof is heard on 9.76A as *early* as 1025 and to *after* 1230 in parallel with 7.50, 9.04, 10.26. (Gay, Calif.)

Radio Ceylon now uses 9.57 to relay VOA to Southeast Asia in *English* 1030-1230. (Gay, Calif.)

A *new* station in Malaya is *"The Forces Broadcasting Service, Singapore,"* heard on 5.010 at 0700-0900 when closes with "God Save the Queen;" *only English* is at opening, closing. (Paris, Gillett, Australia)

Cairo should be *testing* its *new* 100 kw. transmitters to the Americas *soon*.

A letter from the Government of Aden says that *no broadcasting station* is operated there, but that *Cable and Wireless, Ltd.*, makes available a transmitter on request on 6.045, 250 watts; no new developments in radio are contemplated. (Scheiner, N. J.)

Rangoon, Burma, plans to *expand* both its internal and external services—including an *increased* staff, *four new* powerful transmitters, and a *new* Broadcasting House. (Scheiner, N. J.)

The Japanese Short Wave Club says HLKB, Pusan, is now using 2.510 and 7.935 with 1 kw. at 2100-2400, 0300-1030, 1600-1830; Seoul, 9.555, is parallel.

Pan-American Radio, Tangier, plans to extend its schedules soon; has been licensed to increase power of its transmitters. (Scheiner, N. J.)

"La Voz de la Democracia," Quito, Ecuador, announces channels of 5.970 and 9.560; signs off 2335. (Villela, Md.)

A letter from *Radio Vila Verde*, Macau, Pt. China, says there is no short-wave station operating in that colony at present, but that the *Radio Clube* may use its 1 kw. short-wave transmitter on 9.500 later on. *Radio Vila Verde*, while awaiting a new m.w. transmitter, did use the *Radio Clube's* 9.500 station in March-April 1951 *only; there has been no short-wave transmission from Macau since then.* (Scheiner, N. J.)

The VOA relay Base at Salonika, Greece, is to have a *new*, small short-wave transmitter. (Cushen, N. Z.)

* * *

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Please keep those FB reports coming in to 948 Stewartstown Road, Morgantown, West Virginia, USA. Thanks, fellows . . . . . K.R.B.

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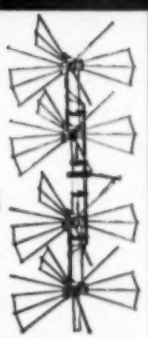

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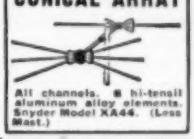

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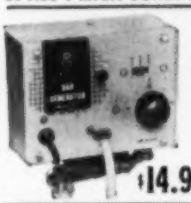

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NEW TV PRODUCTS on the Market

SIGNAL GENERATOR

Receiver and amplifier gain, selectivity, sensitivity, and image rejection are a few of the u.h.f. television measurements that can be made with the new signal generator recently announced by *Hewlett-Packard Company* of 395 Page Mill Road, Palo Alto, Cal.

This master oscillator power amplifier generator is designated as the Model 612A. It offers continuous coverage between 450 and 1200 mc. Frequency and output are directly set and read on large dials. No charts or interpolation are necessary. Maximum output is .5 volt into 50 ohms throughout the frequency range.

Full details and price information are available from the company on request.

"SERVICE CARD FILE"

Oelrich Publications, 4135 N. Lawler Ave., Chicago, Ill., is now offering its #700 "Master Service Card File" business control system.

Designed specifically for radio and television service dealers, the "file" consists of a metal file box, 500 5" x 8" master service cards, and one set of alphabetical index cards. The card functions as a customer account card on which customer information, service details, sales details, warranty, and service contract expiration dates are entered. Cards have spaces for details of 15 service jobs per customer and are printed in brown on buff ledger stock.

A sample card and catalogue are available on request. Parts jobbers will handle this item.

NEW CAMERA COMPONENTS

A package of five electronic components especially designed to complement the *RCA*-6198 "Vidicon" industrial television camera tube has been announced by the tube department of *Radio Corporation of America*, Harrison, New Jersey.

The new components include a deflection yoke (216D1), focusing coil (217D1), alignment coil (218D1), horizontal-deflection-output transformer (233T1), and vertical-deflection-output transformer (234T1). These parts are engineered to provide good sweep linearity, high deflection sensitivity, efficient coupling between circuits, proper focusing, and accurate alignment of the electron beam.

The new "Vidicon" industrial television camera tube with which these components are used is only one-tenth the size of a standard broadcast camera tube. It makes possible the design of compact, simple, lower-cost camera equipment for non-broadcast use.

CR TUBE SHIELD PAINT

Micro-Circuits Company of New Buffalo, Michigan is in production on a new conductive shielding paint for static shielding of CR tubes, meters, high-voltage power supplies, high-voltage generator windings, etc.

The new paint, RS12, is low in cost, has high conductivity, excellent adhesion and durability, heat resistance, and viscosity suitable for spraying, according to the company.

For data and price sheet, MR11, contact Dept. RN of the company.

SERVICE TOOL

Rytel Electronics Mfg. Co. of 9820 Irwin Ave., Inglewood, Cal. is currently offering its new "Glo-Aid," a dual purpose tool that is designed to speed up repair jobs for radio and TV technicians.

Both ends of the new tool have solder-resistant tips. One end has a slot

for securing wire to be soldered. The other end is a high-voltage probe with a neon glow bulb for testing high voltages without danger of shock.

The plastic handle is 5" long and the total over-all length of the tool is 8¾".

U.H.F. LIGHTNING ARRESTER

JFD Manufacturing Co., Inc. of 6101 16th Avenue, Brooklyn 4, N. Y. has brought out a new u.h.f. lightning ar-

rester that minimizes stray capacitances and inductances.

The new unit, the Model #AT103, through improved mechanical and electrical design, lowers impedance to the same uniform 300 ohms which the antenna and receiver offer. This uniformity of impedance over the entire u.h.f. band prevents loss of signal and produces a clearer picture.

The manufacturer will furnish literature on request.

INDUSTRIAL TV CAMERA

A miniature television camera unit, the "Tel-Eye," which is completely self-contained has been introduced by the television transmitter division of the *Allen B. Du Mont Laboratories, Inc.*

The new unit, designed for closed-circuit television, is a complete camera chain with all associated power,

synchronizing, r.f., monitoring and output equipment, plus the camera itself, contained in a small camera head about the size of a portable typewriter case.

It is simple, highly portable, and can be used with any standard v.h.f. television receiver by simply plugging the unit into a standard wall socket and attaching the camera's output cable to the television receiver. It will feed multiple TV receivers with excellent pictures at distances up to 200 feet.

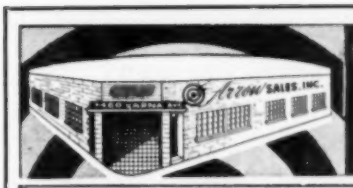
The complete unit measures 14" long, 9⅜" high, and 4⅝" wide. It operates with any standard 16 mm lens and is fitted for mounting to any standard camera tripod. It weighs 18 pounds and uses 17 tubes. It is available for immediate delivery.

TV ATTENUATOR

Blonder-Tongue Laboratories, Inc. of 526-536 North Ave., Westfield, New Jersey has introduced a laboratory-engineered unit which provides precise attenuation ranging from 0 to 42 db, in 6 db steps, over the entire v.h.f. band.

Technicians and installers will find the Model AT-1 attenuator a useful guide in planning TV installations. The unit provides proper attenuation levels for equalizing signal strengths in multi-antenna installations, for reducing TV signals to prevent overloading, and to simulate fringe area reception.

Three switches on the AT-1 allow variable attenuation of 6, 12, 18, 24, 30, 36, or 42 db. The unit requires no power and may be used for testing or



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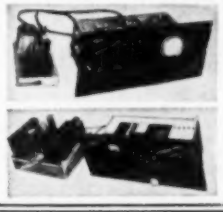

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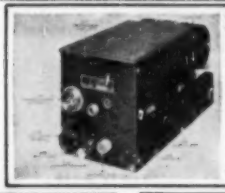

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1B23	8.95	6AN5	2.90	830B	2.75
1B24	9.50	6AS6	2.30	832A	9.95
1B27	12.50	6BL6	99.50	836	3.45
1N21B	2.50	6BW6	99.50	837	1.45
1N22	1.25	6F4	4.50	843	11.50
1N23	1.25	6J4	5.95	849	21.50
1N23A	2.25	5R4	3.90	851	39.50
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1N34A	.79			860	4.50
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permanent installation at any point in a TV line. The 75-ohm terminal strip and the 75- and 300-ohm terminal strip are interchangeable as the input or output.

24" ALL-GLASS TUBES

The television picture tube division of *Sylvania Electric Products Inc.* has developed two new 24-inch rectangular, all-glass television picture tubes which are now available in limited production quantities.

The new tubes have gray filter glass spherical face plates that provide for glare reduction. They are magnetically focused and deflected with an ion trap gun requiring a single external magnet. The tubes are supplied either with or without external conductive coating. They weigh about 32 pounds.

Using a 90-degree deflection angle, the over-all length of the new tubes is 21⅜". Total picture area of 327 square inches is provided by a screen area approximately 17" high by 21½" wide.

The Type ST-1491 is without the external coating while the ST-1491A has the external coating. Tentative data on these tubes is available from the company at Seneca Falls, New York.

IMPROVED GENERATOR

Radio City Products Co., Inc. of 152 West 25th Street, New York 1, N. Y. has announced that its "Do-All" Model 740 generator has been improved to provide increased performance at ultra-high frequencies.

The new model has been designated

as the Model 740A and is being shipped on all orders calling for the Model 740 at no increase in price.

NEW U.H.F. ANTENNAS

Channel Master Corp., Ellenville, N. Y. has developed a twin corner reflector, Model No. 406, an all-channel u.h.f. antenna that is said to provide up to 16 db gain.

Danforth Manufacturing Co., Monmouth, Illinois is offering the "Little Jewel," a u.h.f. antenna of rugged construction. The unit is matched to 300-ohm lead-in and comes completely assembled for easy installation.

Hi-Lo TV Antenna Corporation, 3540 N. Ravenswood Ave., Chicago 13, Ill. is marketing a u.h.f. "Spiral-Tenna"

which is designed to provide u.h.f. and v.h.f. reception. This indoor antenna is 20" high and 32" wide. It is finished in a gold color, has a Bakelite base, and aluminum bars.

JFD Manufacturing Co., Inc., 6101 16th Ave., Brooklyn 4, N. Y. is in production on a stacked u.h.f.-v.h.f. conical antenna, the JeT283S. It comes completely pre-assembled. Performance data is available from the manufacturer on request.

Kay-Townes Antenna Co., Rome, Georgia, has announced its BJU series of high-gain antennas, assembled in kits of 2-bay, 3-bay, and 4-bay units to provide reception on all TV channels. Special features of this series include the company's fixed impedance point system which eliminates isolation filters, matching pads, coils, condensers, or other boosters.

LaPointe Electronics Inc., Rockville, Conn. has released a u.h.f. bow-tie and reflector unit, the Model BT-U. This *Vee-D-X* engineered antenna eliminates insulators and permits all metal construction, thus providing higher gain and flatter response across the entire u.h.f. band.

Radion Corporation, 1130 W. Wisconsin Ave., Chicago, Ill. is in production on a new indoor u.h.f. antenna, the "Bullseye." The antenna is a full-wave loop engineered for broadband coverage, low standing wave ratio, and low "*Q*". It measures 10" high and 9" wide and weighs less than one pound.

Snyder Manufacturing Co., Philadelphia 40, Pa. has introduced an "all-in-one" TV antenna, the UHF-2 "Bow Screen." The new unit covers all u.h.f. and v.h.f. bands. A catalogue illustrating this unit is available from Dick Morris, sales manager of the company.

Television Hardware Manufacturing Co., a division of *General Cement*, Rockford, Ill. has released a series of sensitive u.h.f. TV antennas for all-channel reception. Known as the *Telco* "Butterfly," these new units are said to be highly directional. Single-and two-bay models are currently available.

Telrex, Inc., Asbury Park, N. J. has added an "ultra bow-tie" series of u.h.f. antennas to its line. These units feature high gain, directivity, and good impedance characteristics over the entire u.h.f. band. By means of "sectionalized" design the basic "bow tie" dipole assembly can be used as a primary area antenna without further accessories. Various elaborations may be achieved by use of the company's modification kit or its line of standard components.

Trio Manufacturing Co. of Griggsville, Ill. is offering a new line of low-cost u.h.f. antennas to the trade. The line features two general types—the bow-tie with reflector design and the yagi type. The bow-tie version is available in three all-channel models while the yagi type comes in four models for Channels 14-26, 27-42, 43-60, and 61-83.

DEMODULATOR PROBE

A voltage-doubling crystal demodulator probe for use with a scope or v.t.v.m. in television alignment and troubleshooting is now being offered by *Scala Radio Co.* of 2814 19th St., San Francisco, California.

The BZ-4 probe virtually doubles the deflection on a scope screen, thus providing increased utility in signal tracing low-level i.f. stages and in calibrating generators against crystal oscillator harmonics.

The probe is designed to provide a high degree of 60-cycle hum rejection so that effective tests can be made in heater, a.g.c., and d.c. supply lines for the presence of spurious high-frequency voltages. The probe can be used to localize dead or weak i.f. stages, to calibrate the base line of a scope for ratio detector alignment, to demodulate a video amplifier sweep

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20LP4	37.50	19AP4A	25.90
21EP4A	37.35	20CP4	29.50
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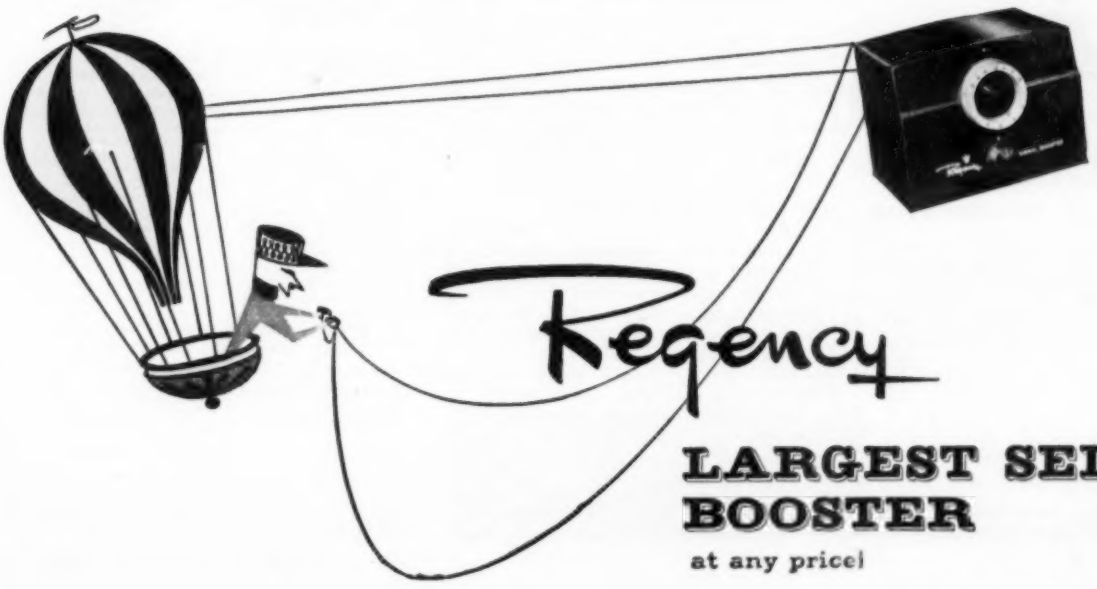

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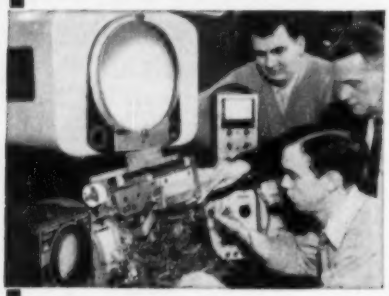

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ELECTRO-VOICE CONVERTER

A new Model 3300 continuous-tuning u.h.f. television converter has been announced by *Electro-Voice, Inc.* of Buchanan, Michigan.

A non-slip micrometer type tuning mechanism provides smooth, continuous tuning of all u.h.f. channels, 14

through 83. No bandswitches, strips, or coils are incorporated. A large fingertip knob with flywheel action operates a legible, slide-rule dial.

Housed in a dark brown cabinet, the unit measures 7¾" x 5¼" x 6¼". Input and output impedances are 300 ohms. The converter is connected to the antenna input of the v.h.f. television receiver and plugged into an a.c. outlet. No other installation procedures are required.

WARD "DIPLEXER"

The Ward Products Corp., 1148 Euclid Avenue, Cleveland, Ohio now has available a compact antenna coupler which has been tradenamed the "Diplexer."

The unit may be used when present v.h.f. installations are converted for u.h.f. and two antennas are required. With the coupler a single lead-in will feed the set from both antennas.

The "Diplexer" is a printed circuit using a "Twin-Tee" filter on which a patent is pending. This circuit gives uniform response over all TV channels, both v.h.f. and u.h.f., and keeps insertion loss at a minimum. Physically, the unit measures less than two inches square. It is factory-sealed in a waterproof plastic case. A mast mounting strap is included with each unit.

TV WAVE TRAP

Non-Linear Systems of Del Mar, California has introduced a television interference filter which is said to effectively eliminate adjacent channel interference as well as FM, amateur, or other interference on any given channel in a TV receiver.

The "NOLS" wave trap features highly selective attenuation of 100 to 1 or better at the frequency tuned. Selectivity is such that the rejected bandwidth is only 2-3 mc. wide, permitting elimination of interference even when it is extremely close to the desired channel.

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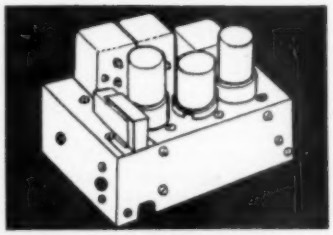

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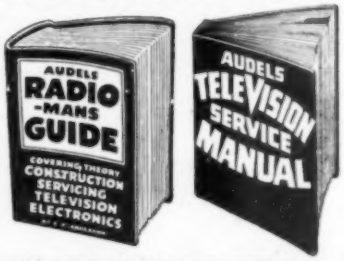

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The trap has balanced input and output circuits for use in a 300-ohm line. It has one simple tuning adjustment and is packaged in a case measuring 4" x 4" x 3". One trap is required for each interfering signal and units may be cascaded for more complex problems.

The traps have a tunable range of from 20 to 40 mc. depending on the model and have been engineered for specific interference problems. The company will supply full details on request.

SIGNAL GENERATOR

A signal generator covering the v.h.f. to u.h.f. frequency range has been developed by *Connecticut Telephone & Electric Corporation* of Meriden, Conn. to meet the needs of engineers and technicians engaged in television and other electronic work.

The instrument covers the range of 54 to 330 mc. in the first band and from 300 to 950 mc. in the second band. The entire generator measures 9½" wide, 11" high, and 14" deep. The instrument is provided with a calibrated frequency dial, a power output meter, calibrated output attenuator (wave guide beyond cut-off), and regulated power supply.

A data sheet giving complete specifications is available on request.

VIDAIRE'S ATTENUATOR

Vidaire Electronics Mfg. Co. of Lynbrook, New York has introduced a new television attenuator that eliminates overloading due to strong signals,

Known as "Tel-Atten," the new unit was designed to reduce buzz in intercarrier sets and most cross-modulation effects. It also features a 1000 to 1 change in signal reaching antenna posts and vernier adjustment for all signal areas.

The Model A-2 measures only 3⅝" x 2⅜" x 1¼" and is housed in a two-color cabinet. It may be mounted on the set itself or on a nearby wall.

UNIVERSAL ANTENNA MOUNT

Walnut Machine, Inc. of South Bend, Indiana has been granted a patent on its universal antenna roof mount, the *Wamco* No. 177 "Uni-base."

Designed to permit any type of roof or side mounting, the unit's compound universal joint swivels 360 degrees for mounting on any pitch of roof, for ridge mounting to fit any pitch of roof, or for vertical mounting to the side of a building. The holding clamps are adjustable to accommodate all masts ¾" x 2" and have full hinge action for raising the mast and guying.

It may be installed by one man. Of steel construction, all parts are weather-resistant treated.

NEW CRANK-UP TOWER

Alprodco, Inc. of Mineral Wells, Texas has introduced a new crank-up television tower, the CV-56S.

Featuring low erection cost, safety, and light weight, the new unit comes completely assembled ready to install. No ground base is necessary. All that is required is that the antenna be mounted, a set of guys attached, and the unit fastened to the house with the company's special stand-off bracket. The unit may then be cranked up to a height of 56 feet.

The tower is made of spring-tempered, hot-dip galvanized steel with rustproof aircraft cable throughout. It is equipped with easy climbing steps.

BOGEN CONVERTER

A new u.h.f. converter, designed to permit reception of all u.h.f. stations on standard v.h.f. television sets, is

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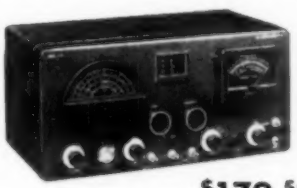

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A-84	$99.50	S-72L	$119.95	SX-62	$299.50
S-38C	$49.50	S-77A	$119.95	S-72 Portable	$109.95
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currently being offered by *David Bogen Company*, 29 Ninth Avenue, New York 14, N. Y.

Known as the UCT, the converter is easily installed by connection to the antenna input of the television receiver. It is completely self-contained in a compact, brown-plastic cabinet that can be placed atop the set.

The new unit features a single knob for continuous tuning over the entire

u.h.f. band from Channel 14 to Channel 83. Its broadband output operates through either Channel 5 or 6 on the TV set. Input and output impedances are 300 ohms.

The UCT measures 4⅞" x 4¾" and is supplied complete with tubes, instructions, and a 300-ohm twin-lead for connection to the TV set.

TWO-SET COUPLER

Snyder Mfg. Co., Philadelphia 40, Pa. is marketing a two-set coupler which permits two television receivers to be operated from a single antenna.

The Model AC-800 is fully automatic and needs no adjustments or switching operations. For permanent installation, it mounts on either receiver or any convenient place between the receivers. It can also be placed in the basement of the home or building.

The unit is housed in a Bakelite case and comes complete with lead-in terminals for quick and easy installation.

FRINGE AREA CHASSIS

Video Products Corporation, 370 Seventh Ave., New York 1, New York has added a new unit to its line of television chassis.

The Model 530 DXC-27 is designed to operate 90 degree deflection tubes. It incorporates a horizontal output transformer of advanced design which, in conjunction with the 6CD6, gives increased high voltage with full deflection for the CR tube. The special yoke used in this chassis gives safe and cool operation for 30" round, as well as 27" and 24" rectangular tubes.

The chassis was also designed to give maximum sensitivity for fringe areas as well as good performance in strong signal areas. It has a four-stage i.f. system with a bandpass wide enough to provide a good picture with sound sensitivity consistent with a good picture.

The company will supply full details on the Model 530 DXC-27. —30—

Relay Sensitivity

(*Continued from page* 39)

prefers, the components may be mounted in a standard metal utility box, such as the popular "Miniboxes" manufactured by *Bud*.

When mounting and wiring the components in a closed box, there is no need to worry about heat dissipation, and parts may be mounted as close together as practical. The only precautions necessary are (a) to prevent jamming the relay armature, and (b) to avoid electrical short circuits.

Since the battery current drain is small, the battery life should approximate the normal shelf life of the batteries, under usual operating conditions (where an "open" *control line* is used).

Parts Substitutions: The parts list need not be followed exactly and should be taken only as a general guide. A relay other than the one listed may be used, and other batteries may be substituted for B_1 and B_2. Let us discuss each component in turn.

The relay chosen should be capable of operating on a few milliamperes coil current. The more sensitive the basic relay, the more sensitive the final assembly. Coil resistance is not too important, although some adjustment in the voltage of B_3 may be desirable. For example, a relay coil of high resistance may require a greater supply voltage to obtain a satisfactory operating current. A relay coil of low resistance may make it possible to use a lower voltage battery for B_3. However, in no case should the maximum ratings of the transistor be exceeded. (For transistor ratings, refer to *"Build This Transistor Receiver"* by R. K. Dixon, February, 1953, RADIO & TELEVISION NEWS.)

Where the relay available in the workshop has almost, but not quite, the desired sensitivity, it is often possible to improve its sensitivity by the standard techniques of reducing the armature spacing and weakening the spring.

As far as battery B_3 is concerned, the choice of this component will be determined, to some extent, by the resistance of the relay coil (as outlined previously). The battery chosen for the model was picked because of its small size, low cost, and ready availability.

The builder may follow his own inclinations in choosing a battery for B_1. The *Mallory* RM-1000 mercury cell used in the model was picked because of its small size and long shelf life. Any of the other mercury "A" batteries will serve as well, however, and the more conventional zinc-carbon batteries may be used if preferred. A penlight cell is a good choice because of its small size, but even a standard flashlight battery may be used.

Series resistor R_1 is chosen for optimum circuit operation, as described

below; however, since the resistor represents a minor item, the builder should experience no difficulty here. The value of R_2 is not critical and any resistance from 300 to 1200 ohms should work well here.

The only remaining electrical part in the circuit is the transistor. Even here substitutions may be made, but where a transistor having different characteristics is employed, these must be taken into account when choosing a relay and operating voltages.

Circuit Adjustment: The relay itself should be adjusted for maximum sensitivity in keeping with good contact pressure. Care must be taken here, and if the builder is unfamiliar with relay adjustment, it may be best not to change the factory adjustment.

Once the wiring is completed, the value of R_1 may be chosen experimentally. The required value will depend upon relay sensitivity, the resistance of the *control line* (if large), and the value of B_1. The author found that the following technique gave satisfactory results.

A decade resistor box was connected in the circuit in place of R_1. It was adjusted for a total of 20,000 ohms resistance. The *control line* was connected and closed.

The resistance was then reduced until positive closure of the relay was obtained. Too large a value for R_1 will either prevent relay operation or make the operation erratic. Too small a value will permit excessive base current flow (as R_1 is reduced, the base current flow increases, as well as the collector current).

A fixed resistor of the nearest RTMA standard value was then substituted for the value indicated on the decade box.

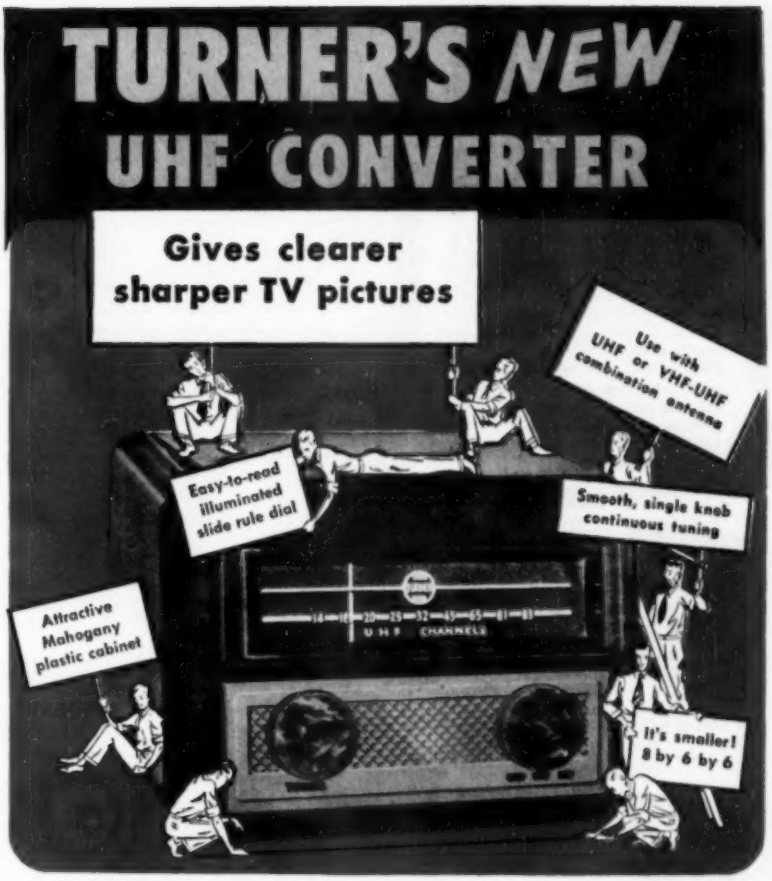
If a long *control line* of fine wire is employed, the resistance of the line may be appreciable. In such a case, the value of R_1 should be reduced for positive relay operation.

Where a general purpose unit is desired, for use with either high or low resistance *control lines*, R_1 may be replaced with a 5000 or 10,000 ohm rheostat, and readjusted as necessary for operating conditions.

In addition to the usual applications of a sensitive relay in electronic control circuits, there are a number of applications in which the relay may serve in its own right. While the builder can undoubtedly think of many of these himself, outlining one or two special applications might be of benefit to the reader.

Burglar Alarm: By installing door and window contacts and fine wire, (or tape foil) a room or area may be completely enclosed by a continuous electrical circuit. This circuit may be used as the *control line* of the schematic diagram, and the relay kept in a "normally closed" position. Any break in the circuit (including battery or relay failure), such as a door or window being opened, will permit the relay to "drop out."

The closure of the relay contacts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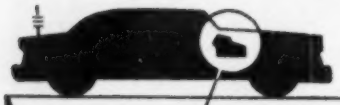

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may be used to turn on an alarm bell, turn on lights, or carry out almost any desired function (the relay contacts are used as a simple switch).

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The "special" thermometer consists of a mercury thermometer in which contact leads have been inserted along the length of the tube. As temperature variations take place, the expanding and contracting mercury column alternately makes and breaks contact between the two leads. The current carrying capacity of such an arrangement is small, however, but it is sufficient to operate a sensitive relay which may, in turn, control heavier circuits.

Other applications: In addition to the two applications already described, there are many other practical applications of a sensitive relay to commercial and industrial work.

But these are not the only applications. A sensitive relay may often be used in novelty control circuits and to operate toys. —30—

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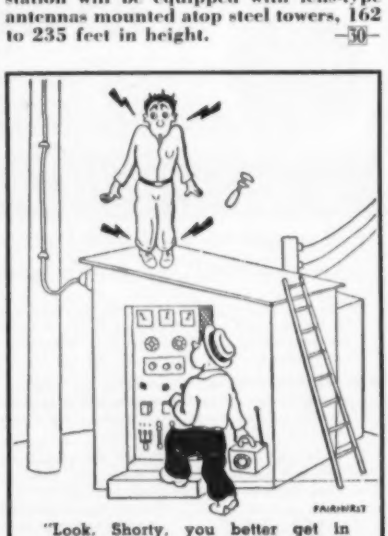
THE Long Lines Department of A. T. & T. has announced plans to construct a radio-relay route between Buffalo and Cleveland.

The proposed 180-mile system, which is needed to handle increased requirements for telephone message service and television channels, is scheduled for completion late this year.

The new system will augment cable and open wire lines as well as provide another link in a planned second radio-relay route between New York and Chicago.

The new Buffalo-Cleveland link will employ five radio-relay stations. Each station will be equipped with lens-type antennas mounted atop steel towers, 162 to 235 feet in height. —30—



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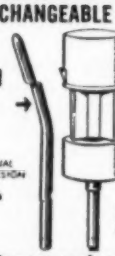

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Spot Radio News

(Continued from page 16)

production would not impair the defense effort."

"Among other conditions," he continued, "applicants had to show that there would be no diversion from defense activities of electronic technicians, design engineers, draftsmen, professional engineers, physicists, or tool and die makers, as a result of engaging in color TV set production."

It was noted that this provision was dictated by the critical need at that time for engineers to develop new electronic equipment for the rapidly expanding programs of the military and the Atomic Energy Commission. Due largely to the cooperation of industry, McCoy added, this development activity proceeded much more rapidly than originally thought possible. Now, it was said, engineering for the defense electronics programs has passed its peak, and producers are meeting current military needs. "With the emphasis now falling on production," McCoy said, "we felt it no longer necessary for NPA to screen applications for permission to produce color television equipment."

With sequential telecasting shelved, compatible broadcasting a purely experimental and unapproved system, the revocation was viewed as simply a policy move of no significance to industry.

CBS received a boost from Richard Hodgson, who during the third day of the hearing declared that manufacturers had actually boycotted the sequential system, a point of view expressed earlier by Senator Johnson.

Dr. Du Mont, who appeared next on the stand, took a dim view of the immediate prospects of a color TV system for the public. He did not agree with others who thought the system was practical. "As far as we are concerned," he said, "we would like to see color tomorrow, if the public would buy it. We are in the business to sell sets . . . but we would not make one we didn't think we could sell. I don't think the manufacturers have color to sell to the public." In his opinion, commercial color is still years away.

The last days of the inquiry were highlighted by the appearance of Dr. Baker, as chairman of the National Television Systems Committee, and ex-FCC Headman Paul Walker.

Baker described how the NTSC came into existence and reported on the present status of the committee's work on color. Noting that the committee's membership includes scientists of the highest standing in a number of different fields of technology, such as electronics, physics, colorimetry, optics, and mathematics, he said that these experts have concerned themselves solely with a significant and highly challenging technical problem; how best to achieve the optimum

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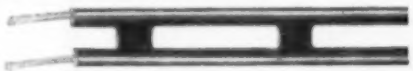

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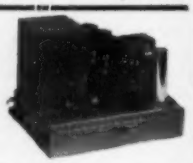

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in terms of a color television system.

Reviewing the background of the group, Baker declared that the idea for such a committee was born in '40, as the result of a conference with former FCC Chairman Fly who was then concerned with problems of standards for a monochrome system. Within six months from the establishment of the first NTSC, Baker said, 168 members and assorted panels had produced reports and minutes totaling 600,000 words, had devoted 8000 manhours to meetings and travel, and had witnessed 25 demonstrations in an effort to find a common ground for black and white system specifications. Despite the fact that then, as now, the NTSC headman added, there were conflicting proprietary interests involved, a substantial concurrence was reached on all important technical considerations. The group's work was so outstanding that Fly paid the following tribute to them: "This is another example of the best that is in our democratic system, with the best in the industry turning to a long and difficult job in an effort to help the government bodies in the discharge of their functions so that a result may be achieved for the common good of all."

Declaring that the problems involved in the '49-'50 color hearings were very similar to those which faced the Commission and industry a decade ago, Baker said that it seemed as if history were repeating itself and there appeared a need for the services of an NTSC. It was hoped that the Commission would request the help of the group, as they did in '40, but the FCC did not, Baker said. Nevertheless the group was formed, but in the absence of any request for assistance from the Commission, relatively little could be done during the hearings (which resulted in the adoption of sequential color).

In April, '51, an *ad hoc* committee report disclosed that there were in existence practically all of the elements essential to the creation of a color system having none of the inherent limitations of the field-sequential plan, the Congressional committee was then told. Both the FCC and chairman of the Senate Committee on Interstate and Foreign Commerce were apprised of this report. However, it was noted, being conscious of the Commission's position with respect to *paper* systems, the committee felt that the proposed idea should be translated into an operating reality. And at all times, it was emphasized, the committee has kept in mind the fact that any proposed standards, must if conceivably possible, be expressed so broadly as to permit the development by individual manufacturers of distinct gear capable of performing under those standards.

To establish such standards, Baker said, engineering committee members have been studying and determining on the basis of demonstrated facts, personally observed, when as a matter

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of technical judgment, adequate solutions have been arrived at to engineering problems, or when the point of diminishing returns has been reached in the pursuit of a line of scientific inquiry.

"The NTSC, as such, makes no inventions; it designs and makes no apparatus . . . has no licenses and holds no patents," Dr. Baker added.

Summarizing, the NTSC chief said that after more than twenty months of work by some 200 top engineers, after countless combinations of elements and possibilities have been painstakingly analyzed and evaluated, after the accumulation of a library of reference material for the engineers of the industry, and after hundreds of lab tests and experiments in scores of plants, the NTSC is unanimously convinced that under its supervision there has been prepared a set of standards capable of producing a superlative system of color television . . . a system which is completely compatible with the receivers now in the hands of the public, and in fact produces a superior monochrome picture, as well as a superior color image.

To be sure that there are no flaws in the system, an intensive field-testing program has been initiated, the Congressmen were told. After these tests have been completed, and all of the NTSC members are satisfied that the system is foolproof, then the Commission will be asked to adopt the standards, by a formal order, based on procedures followed by the FCC in establishing the monochrome standards in '40-'41.

NTSC hopes, it was said, that the Commission recognizes its existence, and lends its active support, and does nothing to interfere with completion of the current field-testing program.

The sincerity of Baker's statement prompted Representative Wolverton to praise his comments and applaud the work of NTSC. "Certainly during the years that have elapsed," the Congressman said, "this committee of which you are chairman, has given unquestioned evidence of a very keen desire upon its part to accomplish something that would be worthwhile to the public and, stripping your work from all thought of commercial advantage to any one individual or set of individuals, until there has been a completion of the work and the objectives that have been set in the early days by your committee."

Approving the recommendations made and the help offered, the Congressional chairman declared that the NTSC has over a period of years given that service that is so highly commendatory that it would be . . . "difficult to find words to adequately express the appreciation of the high purpose that has guided and directed . . . the group . . . through all these years of trial and error; sometimes undoubtedly tribulations, sometimes success; in season and out of season."

Continuing his enthusiastic appraisal of Dr. Baker and the committee,

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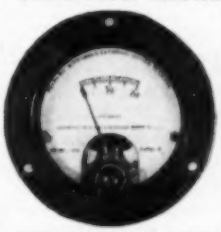

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the Congressman said: "I feel that you have performed a great and outstanding service to your country and its people, and I wish to assure you that there can be no finer recognition of the fine work that has been done by your committee than for this committee to consider carefully and well the recommendations that you have made, and insofar as it has jurisdiction and power to support and sustain you in the recommendations that you have made. They all seem so reasonable. They all seem so logical and certainly they come with force to this committee, because of the quality of the committee that has given the study and made the recommendations."

The calm of the hearing room was shattered by the testimony of ex-FCC Headman Paul Walker, who served notice that the Commission would adhere to its original decision and approval of the disc color system. Thus far, he said, no one has displayed or demonstrated a system that was superior or equal, or as practical. But, he added, the moment anybody presents evidence of a satisfactory compatible system, the Commission will certainly hold hearings and recommend adoption, if the system merits such a move. Walker then declared that the NTSC certainly has standing to request a revision of the Commission's standards, and any proposal which it advances to the FCC will receive the most careful and objective consideration. However, he continued, it is not possible for the Commission to recognize that the NTSC is entitled to any special recognition over other industry groups, or that the Commission is committed in advance to an endorsement of future NTSC findings, or that the Commission should abdicate in any way to the color committee . . . "the exercise of its judgment, critically and objectively, as to the public interest."

Before the Commission alters its view and issues a new set of standards, it was said, its members and staff will insist on full data and information concerning all conditions under which any tests are conducted, and in addition perhaps demonstrations of side-by-side comparisons resulting from different systems of transmission. According to Walker, the principal factors determining acceptance of a new system will be . . . "the extent to which there is opposition to or competition with any system advanced for our consideration, and the extent to which any such system is shown to achieve that degree of excellence which would warrant its acceptance as the basic color television standard."

NEW-STATION authorization activity continued to romp along at the Commission's offices, as examiners worked assiduously to process applications.

Nearly fifty more were on the approval list, as this column was being prepared; see page 84.

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Thus far, forty-nine new outlets have actually begun operation since the freeze lift. Of these twenty-nine are now on the very-highs and twenty on u.h.f. as of April 20th. It is expected that at least a dozen more will be on the air when this issue goes to the mailroom at the printers.

According to some estimates, well over a hundred new telecasters will be in operation before the year is over, bringing the total number of TV stations on the air to over 200. In '54 the experts say, at least 400 stations will be operating on commercial basis, with most telecasting on the bands upstairs.

A NEW COMMISSIONER has joined the ranks of the FCC, replacing recess appointee, Eugene M. Merrill, who was named by former President Truman. His name, John C. Doerfer, and his former post, chairman of the Wisconsin Public Service Committee.

Rosel H. Hyde, veteran member of the Commission, has been named FCC chairman for one year, succeeding Paul A. Walker who will remain a Commissioner until his term expires in June.

Mr. Hyde served on the old Federal Radio Commission and then successively as an attorney, hearing examiner, assistant general counsel, and general counsel.

Everyone in Washington feels that Mr. Hyde is more than well qualified to serve as the official spokesman for the Commission and his appointment is a popular one in the Capitol City with both political parties.

EDUCATIONAL TV, which has been tossing about in a stormy sea of politics, will soon undergo the official scrutiny of the Senate Commerce Committee, under the guidance of Senator Tobey, the committee's chairman. Debated will be the knotty problem of channel-reservation continuation for schools, who faced by financial and legislative problems, have been unable to receive official permission to ask for a channel or build if a channel were set aside. The hearing room will undoubtedly be a lively one, for commercial interests will certainly be there to stake a claim for these precious frequencies. . . . . L.W.

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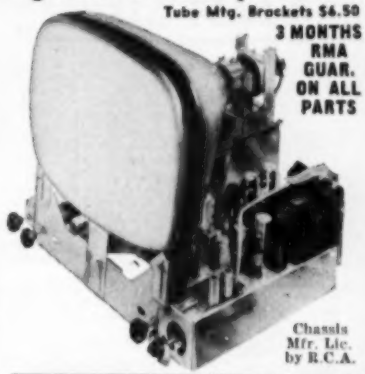

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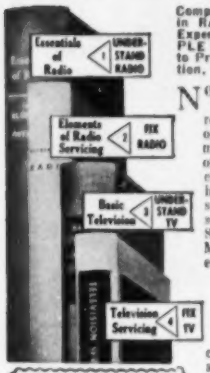

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(Continued from page 51)

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5013			P-3165	R-34A	TV-24R94
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5023	TP-360 & FO-615	P9731	P-3078	R-38BC	T-26R00
5027	TP-360 & FO-615	P9731	P-3078	R-38BC	T-26R00
5117			P-3169		
MAGNAVOX					
300045G1	TP-410	P9713	P-3059	R-33BC	T-26R19
300045-1	TP-410	P9713	P-3059	R-37BC	T-26R00
300059-1	TP-382		P-3069	R-38BC	T-26R00
300059G2	TP-382		P-3069	R-38BC	T-26R00
300060-1	TP-355 & PH-30A		P-3067, 2950	R-33BC	T-26R19
300064-1			P-3076, 3074		
MAJESTIC					
D9.235		P9731	P-3067	R-33BC	T-26R19
D9.252 (D-9252)	TP-370	P9711	P-3070	R-39BC	T-26R21
D-9252A	TP-370*		P-3076, 3074		T-26R21
Models 12C4, C5, T2, T3; 16C4, C5, T2, T3; 16K1		P9711	P-3067	R-38BC	T-26R00
MECK					
FA-10001		P9731			
TP-10002		P5511†	P-2944†	F-13X	T-21F08
TP-10003	TP-400†* & FO-63	P9707	P-3059	R-33BC	T-26R19
TP-10003B	TP-400 & FO-63	P9711	P-3059	R-38BC	T-26R00
TP-10004A		P9711	P-3059	R-38BC	T-26R00
Models MM614C, T; MM616C, T; MM619C; XSB	TP-400 & FO-63		P-3067		T-26R19
MOTOROLA					
25B600684	PV-60†	P9204		R-8A	
25B790140		P5511	P-3074	F-52X	T-21F60
25C90025	TP-400	P9707	P-2956*	R-33BC	T-26R19
25C90026	TP-400	P9707	P-2935	R-33BC	T-26R19
25C484095	TP-450	P9725	P-3067	R-40BC	
25C700161	TP-315	P9715	P-3069	R-39BC	T-26R21
25C700161-9			P-3069		
25C700169	TP-315	P9715	P-3059	R-39BC	T-26R21
25C701025	TP-315	P9713	P-3069	R-39BC	T-26R21
25C701127		P9715	P-3069	R-37BC	T-26R00
25C710636			P-3069		
25K700882	TP-315	P9715	P-3069	R-39BC	T-26R21
Models 16F1, 16K2, 16T1		P9715	P-3074		T-21F60
MUNTZ					
D-9252	TP-405*		P-3070		
TP-0015-C	TP-370†	P9705	P-3059	R-33BC	T-26R19
TP-0018	TP-380† & FO-63		P-3069	R-35BC	T-26R19
TP-0019	TP-380 & FO-615				
TP-14			P-3070	R-38BC	T-26R00
TP-15			P-3070	R-38BC	T-26R00
TP-15C			P-3070	R-38BC	T-26R00
TP-16	TP-370	P9705	P-3070	R-42BC	T-26R25U
TP-17		P9705	P-3070	R-42BC	T-26R25U
OLYMPIC					
TR-1351	PH-200	P9405	P-2955†	R-20B	T-26R23
TR-1474	TP-355	P9713	P-3059	R-35A	T-26R19
TR-1688	TP-355†	P9713	P-3059	R-38BC	T-26R00
TR-1966	TP-360	P9713	P-3059	R-35BC	T-26R19
Models 762, 783, 967, 968, 970	TP-355	P9713	P-3070		T-26R19
PACKARD-BELL					
86036	TP-370 & FO-63	P9731	P-3066	R-38BC & F-52X	T-26R00
89027A			P-3166	R-31A	T-26R00
89030			P-3166	R31-A	T-26R00
89032	TP-360**	P9708	P-3169	R-33A	T-26R19
89033			P-3166	R-32A	T-26R00
89035	TP-370*	P9705	P-3067	R-42BC	T-26R25U
89036B	TP-370 & FO-63		P-3066	R-38BC	T-26R00

*Add Series Resistor to Reduce "B+" Voltage. †Drill New Mounting Holes.
**Use Universal Mounting Brackets.

(To be concluded next month)

Technical BOOKS

"TV TEST INSTRUMENTS" by Milton S. Kiver. Published by *Howard W. Sams & Co., Inc.*, Indianapolis 5, Indiana. 148 pages. Price $3.00. Paper bound.

As the author states in the preface, this book is designed to foster a better understanding between the service technician and the test instruments with which he works. By making "friends" of his servicing aids the technician can do more work in less time and, as a result, become a better service technician.

The book is divided into seven sections covering the v.t.v.m., AM signal generators, sweep signal generators, oscilloscopes, special TV test instruments, TV and FM receiver alignment, and the use of test instruments in TV servicing.

Each of the sections covering specific equipment includes a general discussion, an explanation of the operation of the unit, and then applications of the equipment are discussed. Photographs and circuit diagrams of commercially-available units have been used to amplify the text material.

The book is clear, down-to-earth, and easy-to-understand. The "old hand" at the servicing game will derive as much benefit from this text as will the apprentice technician.

* * *

"UHF CONVERTERS" by the Sams Staff. Published by *Howard W. Sams & Co., Inc.*, Indianapolis 5, Indiana. 42 pages. Price $1.00. Paper bound.

This information-packed little book tells how u.h.f. converters are designed and how they work. It provides a detailed description of all the popular converter designs and explains how they work with present v.h.f. sets.

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A TV allocation table for all 82 channels is also included for ready reference.

* * *

"SOUND REPRODUCTION" by G. A. Briggs. Published by *Wharfedale Wireless Works*, England. 364 pages. Price $6.75. Third Edition. Available in the U. S. at *The British Book Centre*, 122 E. 55th Street, New York, N. Y.

The popularity of the first two editions of this work has dictated the release of this revised and enlarged third edition.

New material in this edition includes data on high fidelity, room acoustics, cone resonance, resonators, vented enclosures, transient response, response curves by oscillogram, the ear, interference, magnetic recording, recording technique, pickups, and home recording.

The book is divided into two main

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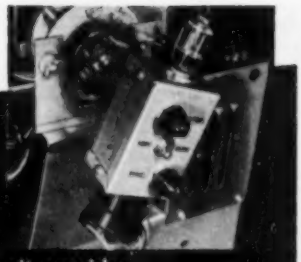

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A highly efficient, portable, lightweight unit provides servicemen with the sensibly engineered Television Bar Generator. On the spot accurate linearity adjustments.

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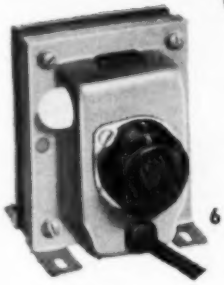

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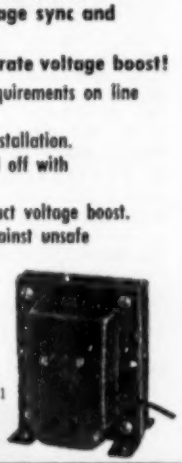

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sections and 28 chapters. The first 18 chapters in Part 1 deal with loudspeakers, their application, performance, and design. The balance of the material appears in Part 2 under the general heading of recording.

Since this work is addressed to the layman, the treatment is non-technical but much of the data would be of considerable value to the audiophile or the technician working with high-fidelity equipment. The book is lavishly illustrated with actual oscillograms, performance graphs, circuit diagrams, and photographs.

The author's style is refreshingly witty so that the book makes good as well as informative reading.

* * *

"TV SERVICING SHORT-CUTS" by Milton S. Kiver. *Howard W. Sams & Co., Inc.*, Indianapolis 5, Indiana. 98 pages. Price $1.50. Paper bound.

This handy, pocket-sized book contains a wealth of practical information in its relatively few pages. The approach to troubleshooting is straightforward and informal.

The material is presented as "Case Histories" with actual receiver chassis and service faults being discussed. Each "Case History" first lists the complaint as the set-owner might report it to the technician. The discussion then outlines the technical reasons behind the complaint and then a series of steps the technician should follow to cure the fault.

A cross-referenced index permits the service technician to find data on a specific complaint irrespective of the chassis make and model involved. The text is well illustrated with CR tube patterns and circuit diagrams of portions of the circuits involved in the specific fault.

As is the case with all of Mr. Kiver's writings, the material is clear, easy-to-read, and authoritative.

* * *

"HOME MUSIC SYSTEMS" by Edward Tatnall Canby. Published by *Harper & Brothers Publishers*, New York. 296 pages. Price $3.95.

How can a layman select a satisfactory high-fidelity sound system which will meet both his economic and aesthetic requirements? The author, a well-known record columnist, has provided the answer in this informal and easy-to-read handbook for the non-technical music enthusiast.

The author discusses the various components comprising a home high-fidelity system and then outlines the desirable performance characteristics which the equipment should possess. Various commercial models are illustrated and described with prices being included as a guide to assembling systems in different price classes. Separate chapters on amplifiers, the speaker, the record player, speaker enclosures, etc. provide a "guide book" for those making excursions into the high-fidelity field for the first time. Correct placement of the equipment and other pertinent data is also included. —30—

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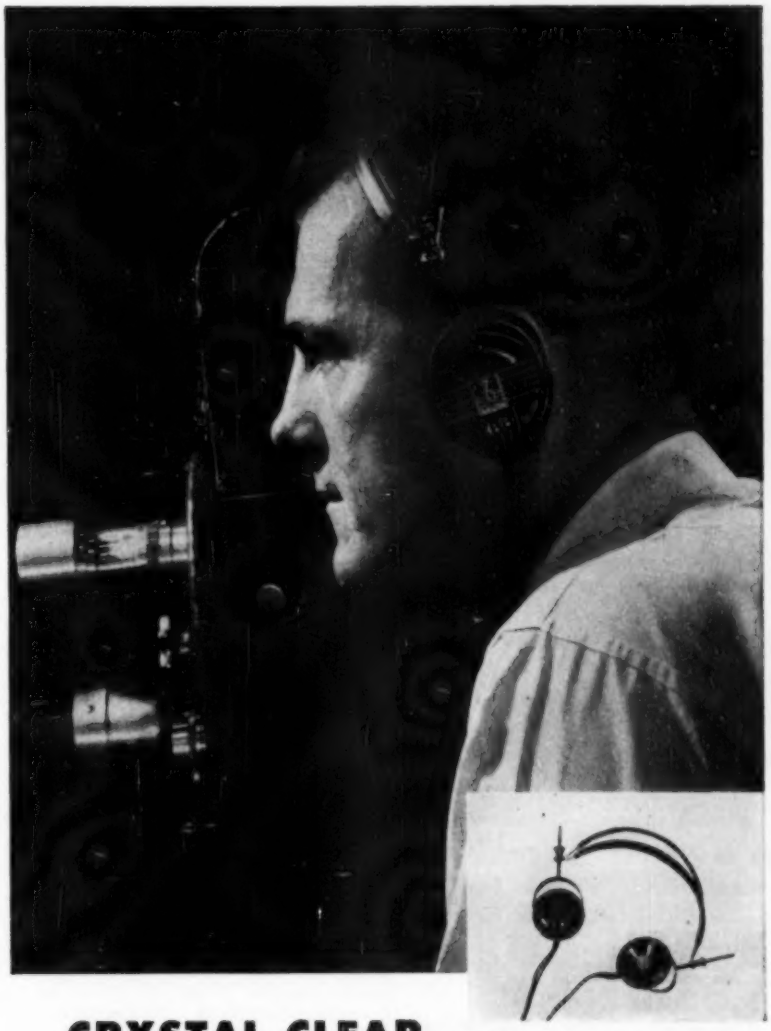
Communications in Korea

(*Continued from page* 38)

four stations assigned to the same frequency. These are carefully chosen considering the distance between each and the direction in which the antenna will be pointed. However, many times frequency assignments that appeared "clear" have been blocked by stations 200 and 300 miles away with antennas close to sea level. In some of these cases the interfering station has had its transmitting antenna oriented at right angles to the receiving antenna yet the interfering signal would be just as strong as that produced by the desired transmitter only 15 or 20 miles away. This may be explained on the basis of sporadic "E" layer, skip, or multiple reflections from intervening terrain features.

There is much more, though, to installing the station than drawing profile charts of the transmission paths. After the preliminary engineering of the system has been completed, survey teams are sent out to each proposed site to conduct a reconnaissance of the area. These teams usually carry a receiver and small power unit with them to test the shots that will be used on the system. Plans have been drawn to equip a helicopter with v.h.f. equipment and dispatch it to the proposed mountain top. The "Chopper" will then hover at standard antenna height and conduct transmitting and receiving tests with the distant station.

When the survey teams (or helicopter) return, their reports are studied carefully to see if the terrain is such that the station can be installed and maintained throughout the year. If the site appears suitable, the full team is sent out with all the necessary equipment and supplies. The team will then set up a base camp as close as possible to the mountain and arrange for laborers at the nearest village. Working with Korean "papasans" the thousands of pounds of gear are hand-carried up rocky, winding trails cut in the side of the mountain. Take the case of "Boston" relay station located in central Korea on a high peak. This station has over 20,000 pounds of operating equipment not including the buildings that house the men and equipment. Each day, all year round this station requires 1500 pounds of gas, oil, and rations. Every day a line of laborers starts up the steep trail with gas cans or cases of food. Heavier loads are carried on "A" frames strapped to their backs. The climb takes about three-and-a-half hours but "papa-san" takes it in his stride. The loads that these men carry are staggering: During the installation of a station these laborers carry complete 315-pound power units to the peak in little more time than it takes a G.I. to climb it with no load. The record, however, belongs to one aged "Chige" bearer that



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packed a 400-pound squad tent up a rugged peak and turned right around to bring another load up the mountain that same day.

Now well established, "Boston" relay is a beautiful spot. An operations shack houses all the equipment and neat runs of coaxial cable fan out to the transmitting and receiving fields. Power is supplied by five 1000 watt gasoline driven generators dug into the side of the mountain and protected from the weather by a bunker constructed of local timber. The antenna arrays are mounted on masts up to 50 feet in height and guyed every 5 feet to withstand winds up to 80 miles-an-hour.

At some of the larger terminals, the standard antennas are mounted on fixtures constructed of 70-foot poles and 20-foot crossarms. This arrangement reduces the space requirements where many antennas must be erected and simplifies both the job of "cutting" the elements to frequency and maintaining them periodically.

The men at the different stations have simplified the job of replacing equipment by the addition of ingenious switching systems that transfer antenna coax, power, and input cables from one unit to another. The terminals in Seoul have such an arrangement, and, in addition, a monitor phone that can be patched into any circuit of any system to aid in trouble-shooting. A bank of indicator lamps shows at a glance which equipment is operating in any circuit at any given time and to which circuit the monitor phone is patched.

Not only can helicopters be used for survey purposes, as mentioned previously, but they can be used to install the station itself by acting as a flying elevator from the base camp to the mountain peak. This method was actually attempted several times during the past two years.

While it would be possible for a lightly loaded "Chopper" to hover some distance above the peak for a reception test, experience has shown that the wind at high altitudes and the thinness of the air make it dangerous to carry the heavy loads required close enough to the peak so that they may be lowered by winch. Air drops, however, have been made several times to stations that have been isolated by storms. One Air Force station was kept supplied for an entire winter in such a manner with everything from 55-gallon drums of gas to fragile crystal units.

An unusual solution to the problem of a unit commander keeping in telephone contact with his headquarters while he was touring the front was solved very neatly by the use of v.h.f. equipment. As shown in one of the photographs, the transmitter, receiver, and one antenna are mounted in a jeep and the other antenna and power unit were installed in the trailer behind. Through the use of voice frequency ringing equipment the operator of any switchboard in Korea could

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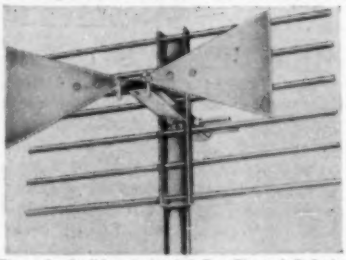

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ring the telephone in the jeep, and, conversely, the commander could establish a direct telephone circuit through his home switchboard while moving or stationary. The voice frequency ringer converts the 20-cycle output of the standard switchboard into a 1000-cycle note interrupted 20 times a second which can be transmitted over a voice circuit. At the distant terminal, in this case the jeep, another ringer converts the 1000-cycle ring back to 20-cycle ringing current which can be accepted by a switchboard or local telephone. The antennas in this case are polarized vertically and have the reflector and director removed to minimize directional effects.

To give an idea of the extent of v.h.f. systems now in use in Korea, it would require at least 30,000 miles of wire circuits to duplicate the facilities provided by the v.h.f. radio relay systems. This figure is based on the air-line "lengths" of transmission paths. The wire figure would undoubtedly be much higher due to the fact that wire routes usually follow existing roads or valleys which do not usually run in a straight line to the distant headquarters.

In World War II v.h.f. was used only as far down as Corps headquarters and only rarely to Divisions. Now, in Korea, v.h.f. serves every American regiment on the line. This means that each regiment has three voice circuits and four teletype circuits that can not be cut by the enemy, that will not break under the weight of heavy ice loads, and, most important: that will "follow" the headquarters as fast as a ¾ ton weapons carrier with the equipment installed can be driven to the new site.

The work necessary to install, operate, and maintain a chain of v.h.f. stations has been proved to be only a fraction of that required for similar wire routes when extended distances are involved. Under the conditions encountered in Korea where communications are subjected to severe winters, guerrilla attacks, and flash floods that sweep over wide areas, v.h.f. radio relay systems have provided high quality, efficient, noise-free telephone and teletype circuits for the UN Command. -30-

BRITISH SCOUT STATIONS

SPECIAL licenses have been authorized in Great Britain for low-power stations to be used in the training of Boy Scouts in radio telegraphy, according to "Wireless World."

Frequencies have been assigned in the amateur two-meter band for training nets made up of five-watt fixed stations working a given number of one-watt portable stations within a ten-mile radius. All stations in the net operate under the call sign of the fixed station with added suffixes "/1," "/2," etc. Contacts may be made only within the net and on c.w. only; other operating conditions are generally the same as stipulated for amateur stations.

-30-

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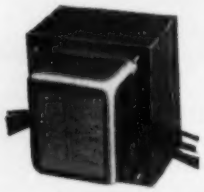
#1H4,1H6,1J6,6B7,6F5,6G5,6SD7,6SH7,6H7, 7S or 8D . . . . . ea. 39c
#35,39,45,71A,77,1L4,3Y3,5Y4,5Y4G,6AU6,6F6, 6J5,6J6,6C5,6K6,6SA7,6SK7,6SQ7,6U7,6W4, Os4,7A4,7B6 or 7G7 . . . . . ea. 59c
#1A7,1LC6,1LH4,2A5,2A6,6A3,6A6,6A8,6B8, 6SC7,6SF5,6SN7,7A7,7AG7,7C5,7C6,7V4, 12AU7,12SN7,47,50,57,58 or 81 . . . . . ea. 69c
"DIRECT FACTORY SPEAKER REPAIRS SINCE 1927" Min. order $3.00. 20% deposit req. on all C.O.D.'s. Full remittance with foreign orders. Please add sufficient postage—excess refunded.
LEOTONE RADIO CORP. 67 Day Street New York 7, N. Y.

to add increased brilliance to any TV PICTURE TUBE

manufactured by
Perma-Power COMPANY
Chicago 25, Illinois
Manufacturers of Electronic Equipment Since 1928

ONLY ONE

OF ITS KIND!



THE THORDARSON-MEISSNER T-26R00

■ Here is the only truly universal replacement power transformer made!

The T-26R00 is the perfect replacement power transformer for OVER 1200 existing TV models and will serve as replacement in over 90% of present and proposed TV sets! No longer is it necessary for the serviceman-dealer to stock 25 or 30 different power transformer types to cover the replacement field. Although the T-26R00 was designed primarily for TV use, it also fully meets requirements in many other applications.

TAPPED SECONDARY WINDINGS

The T-26R00 has tapped secondary windings with output voltages of 600 volts c/t, 720 volts c/t, 840 volts c/t at 295 ma. One 5V, 6A. and one 5V, 3A rectifier windings and four 6.3V, 3A. heater windings.

THORDARSON - MEISSNER advanced design combines new non-hygroscopic insulation with new improved silicon steel core laminations to reduce size, increase efficiency and provide higher voltage protection. The T-26R00 contains dual electrostatic shields, heavy copper flux-shorting band and external steel end shields.

SPEEDS REPLACEMENT JOBS

The T-26R00 has long UL approved color-coded leads and a coded diagram is printed on the shell to facilitate the replacement connections and trouble shooting. Four auxiliary brackets are furnished, for easy upright or flat mounting above or below chassis.

USE THE BEST—THORDARSON-MEISSNER T-26R00. Your Jobber stocks them. Ask him for a copy of the THORDARSON-MEISSNER TV Replacement Guide.

THORDARSON-MEISSNER

MT. CARMEL, ILLINOIS

SPEAKER RECONING

Complete line Cones, Spiders, Rings and Voice Coils. Custom Built Voice Coils. Low prices. Write for Parts List and Reconing information.

WESTERN ELECTRONICS CO.

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RADIO SERVICEMEN!

Write for SENSATIONAL CATALOG

HENSHAW RADIO SUPPLY

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RADIO-TV Service Industry News

AS REPORTED BY THE TELEVISION TECHNICIANS LECTURE BUREAU

IT HAS BEEN an interesting experience to observe the transition of the electronics servicing activity from basically technical thinking to the primary considerations of good management practices. Paced by the rapidly shifting requirements for television service, electronics service business operators found that a large volume of service work was no assurance of profitable operations. In an inefficiently managed service business a large volume of business hastened the day of failure. The service business operator of today who enjoys good credit from his suppliers has learned to apply good management practices in the operation of his business. He may be a top-flight technician in his own right but he devotes the bulk of his time and attention to the business phases of his activity.

Back in radio service days it was an outstanding shop that was able to do $25,000 worth of service business per year. The average annual volume of business for radio service shops before the war was less than $6000 per year. Very few radio service shop operators were able to keep as much as $200 per month for themselves after paying the various costs involved in their service work.

Today it is not uncommon to find electronic service businesses that are handling an annual volume of $150,000 in service work and quite a few shops are doing a quarter of a million or more per year. Where that much service volume is handled the chances of losing money through inefficient management are plenty. If ten men are employed and their time not carefully scheduled and supervised an hour a day per man can easily be lost. For a year's time this would add up to the incredible total of 2600 hours for an organization of that size at a cost to the business of more than five thousand dollars.

This is but one facet of a major service business that can leech away operating income to the point that the business ends up with an operating loss instead of a profit. Many TV service contractors went broke while they were doing a land-office business because they failed to maintain proper operating controls on their businesses.

The management of a modern electronics service business is a very complex operation. It requires substantial financing; advertising and service sales promotional programs must be used regularly and they must be effective in keeping a reasonably consistent volume of business coming in; accounting records must reflect the general "health" of the business through regular operating statements; and there must be a service business control system in operation that will insure prompt handling of customers' calls, maximum employment of technicians' time in productive work, proper accounting of monies handled by employees and adequate records on the use of parts, supplies, and tubes.

Opportunities in the electronics service business will grow with the expanding industry. The service shop operators who aspire to grow with the industry will be buying future business insurance by utilizing good business operating practices while they are still small. Accounting, customer handling, stock control, and employees' time control systems should be both efficient and sufficiently flexible to grow with the business.

Progress of U.H.F.

The first and paramount lesson the industry has learned about u.h.f. TV is that it is no "business bonanza." It is not a fast-dollar business like v.h.f. was in the early days. But it is a business that will add stable volume to the efficiently managed and technically competent service organization that prepares now to understand the peculiar quirks of u.h.f. in its own section.

Every u.h.f. channel will present its own individual reception problems and each section of the country will have to whip its local tropospheric and terrain problems. The glowing reports of u.h.f. reception in Portland, Oregon, resulted in over-selling u.h.f. in Atlantic City. Everybody in the latter city over-bought and over-sold—but the consumers did not "buy" u.h.f. in a hurry. The Atlantic City debacle

BUILD 15 RADIOS

AT HOME

With the New Improved 1953
Progressive Radio "EDU-KIT"

ONLY $19.95

NOW INCLUDES
SIGNAL TRACER
and
CODE OSCILLATOR

- FREE TOOLS WITH KIT
- ABSOLUTELY NO KNOWLEDGE OF RADIO NECESSARY
- NO ADDITIONAL PARTS NEEDED
- EXCELLENT BACKGROUND FOR TELEVISION
- 10-DAY MONEY-BACK GUARANTEE

WHAT THE PROGRESSIVE RADIO "EDU-KIT" OFFERS YOU

The Progressive Radio "Edu-Kit" offers you a home study course at a rock bottom price. Our Kit is designed to train Radio Technicians, with the basic facts of Radio Theory and Construction Practice expressed simply and clearly. You will gain a knowledge of basic Radio Principles involved in Radio Reception, Radio Transmission and Audio Amplification.

You will learn how to identify Radio Symbols and Diagrams; how to build radios, using regular radio circuit schematics; how to mount various radio parts; how to wire and solder in a professional manner. You will learn how to operate Receivers, Transmitters, and Audio Amplifiers. You will learn how to service and trouble-shoot radios.

You will learn code. You will receive training for F.C.C. license. In brief, you will receive a basic education in Radio exactly like the kind you would expect to receive in a Radio Course costing several hundreds of dollars.

THE KIT FOR EVERYONE

The Progressive Radio "Edu-Kit" was specifically prepared for any person who has a desire to learn Radio. The Kit has been used successfully by young and old in all parts of the world. It is not necessary that you have even the slightest background in science or radio.

The Progressive Radio "Edu-Kit" is used by many Radio Schools and Clubs in this country and abroad. It is used by the Veterans Administration for Vocational Guidance and Training.

The Progressive Radio "Edu-Kit" requires no instructor. All instructions are included. All parts are individually boxed, and identified by name, photograph and diagram. Every step involved in building these sets is carefully explained. You cannot make a mistake.

PROGRESSIVE TEACHING METHOD

The Progressive Radio "Edu-Kit" comes complete with instructions. These instructions are arranged in a clear, simple and progressive manner. The theory of Radio Transmission, Radio Reception, Audio Amplification and servicing by Signal Tracing is clearly explained. Every part is identified by photograph and diagram. You will learn the function and theory of every part used.

The Progressive Radio "Edu-Kit" uses the principle of "Learn by Doing." Therefore you will build radios to illustrate the principles which you learn. These radios are designed in a modern manner, according to the best principles of present-day educational practice. You begin by building a simple radio. The next set that you build is slightly more advanced. Gradually, in a progressive manner, you will find yourself constructing still more advanced radio sets, and doing work like a professional Radio Technician. Altogether you will build fifteen radios, including Receivers, Transmitters, Amplifiers, Code Oscillator and Signal Tracer.

The Progressive Radio "EDU-KIT" Is Complete

You will receive every part necessary to build 15 different radio sets. Tube kits with tube sockets, chassis, variable condensers, electrolytic condensers, mica condensers, paper condensers, resistors, line cords, selenium rectifiers, tie strips, coils, hardware, tubing, hookup wire, solder, etc.

Every part that you need is included. These parts are individually packaged, so that you can easily identify every item. Tools are included, as well as an Electrical and Radio Tester. Complete, easy-to-follow instructions are provided.

In addition, the "Edu-Kit" now contains lessons for servicing with the Progressive Signal Tracer, F.C.C. instructions, quizzes. The "Edu-Kit" is a complete radio course, down to the smallest detail.

TROUBLE-SHOOTING LESSONS

Trouble-shooting and servicing are included. You will be taught to recognize and repair troubles. You will build and learn to operate a professional Signal Tracer. You receive an Electrical and Radio Tester, and learn to use it for radio repairs. While you are learning in this practical way, you will be able to do many a repair job for your neighbors and friends, and charge for which will far exceed the cost of the "Edu-Kit." Here is your opportunity to learn radio quickly and easily, and have others pay for it. Our Consultation Service will help you with any technical problems which you may have.

FREE EXTRAS IN 1953

• Electrical and Radio Tester • Electric Soldering Iron • Book on Television • Radio Trouble-Shooting Guide • Membership in Radio-Television Club • Consultation Service • Quizzes • Training for F.C.C. License.

The Progressive Radio "Edu-Kit" is sold with a 10-day money-back guarantee. Order your Progressive Radio "EDU-KIT" Today, or send for further information.

We pay shipping charges all over the world, if you send check or money order for $19.95 with your order. On C.O.D. orders, you pay cost of delivery.

PROGRESSIVE ELECTRONICS CO.
497 UNION AVE., RN-19, Brooklyn 11, N. Y.

threw a cold, wet blanket on u.h.f. enthusiasm in many areas.

However, u.h.f. has been sold more sensibly and sanely in areas that have followed Atlantic City with stations on the higher channels. These u.h.f. TV station promotions have been tempered to avoid over-selling and industry elements are accepting the fact that only experience in working with propagation in the new channels will solve the vexatious problems that are a part of it. Such things as complete dead spots within what should normally be the primary signal area of a u.h.f. station can only be solved by much experimentation with broadcast antennas and associated equipment. Converter manufacturers are very conscious of the difficulties encountered from the beats that are set up between converter oscillators and the set oscillators which at some u.h.f. frequencies completely override the signal. New circuitry will be developed to overcome such difficulties.

It may prove to be a boon to v.h.f. TV reception that indoor antennas have not proven universally acceptable in u.h.f. primary signal areas. The mad scramble to sell v.h.f. sets as a quickly installed "package" item certainly has not given the public the quality of pictures that are possible on present-day receivers. Perhaps the set manufacturers will join with dealers and service people to make the public "antenna conscious" for best picture quality.

These developments augur well for the service industry and especially so for the adequately financed, business managed service companies. But they do pose a responsibility for service business management to get acquainted with the eccentricities of u.h.f. before they have to work with it.

Chicago PR Service Plan

A few months ago a number of the leading television service contractors in Chicago asked the National Appliance and Radio Dealers Association to call a meeting of service people in the Chicago area to discuss ways and means of financing a public relations program to the set owning public that would erase the average user's misconceptions about the simplicity of TV servicing. Since more than five hundred major service contractors have joined NARDA in recent months and the NARDA Service Committee is headed up by Harold Chase, president of the outstanding Television Service Association of Michigan, NARDA leaders accepted the proposal and called a meeting.

Out of this and subsequent meetings the temporarily named Chicago CTIS committee was formed. Its president *pro tem* is Howard Shapiro, head of the *CET* service organization in Chicago, and the chairman of its advertising and public relations committee is Norman Foster of *Foster TV*.

The important facts this committee plans to get across to the set owning public are:

WHEN YOU ORDER
WELLS
COMPONENTS...

HERE'S WHAT YOU GET

1. IMMEDIATE DELIVERY FROM STOCK (in any quantity)
2. FINEST QUALITY OF FAMOUS BRANDS
3. GENERALLY LOWER PRICES
4. RETURN PRIVILEGE FOR FULL CREDIT IF NOT SUITED TO YOUR REQUIREMENTS

The valuable service Wells provides to the industry is being used by many of our greatest manufacturers as a matter of course.

Our vast stock (the world's largest) may contain just the components you need to fill urgent orders — at a substantial savings in time and cost.

ADEL CLAMPS • ANTENNAS, Insulators, Mast Sections • BINDING POSTS • BLOWERS • CABLE ASSEMBLIES • CHOKES • COILS • CONDENSERS Oil Filled, Bathtub, Hearing Aid, Transmitting Micas, Silver Micas, Ceramic, Variable, Trimmer • CRYSTALS • FILTERS • FUSES & MOUNTINGS • GENERATORS • GROUND RODS • HEADSETS • I.F. COILS • JACKS • JACK BOXES • KEYS, Telegraph KNOBS • LAMPS • LORD MOUNTS • LUGS MOTORS & BRUSHES • PLUGS • RECTIFIERS Selenium, Copper Oxide, Meter, Diode • RESISTORS—All Types • SELSYNS • SOCKETS • SWITCHES Aircraft, Micro, Switchettes, Toggle • TIMERS • TUBING—Flexible • TUNING SHAFTS • TRANSFORMERS All Types • VIBRATORS • WALKIE TALKIES

DYNAMOTORS

OVER 100,000 NEW DYNAMOTORS IN STOCK!

DM 32A — DM 53A — PE 86 — PE 101C
DM 33A — D 101 — PE 94, etc.
Large quantities of brushes for all types of dynamotors and meters.

Write us for quotations. Advise us your requirements.

A complete Signal Corps stock number listing of items in our stock. Write for listing No. SG-200. (For government agencies and contractors only.)

Manufacturers and distributors—write for new Condenser Catalog C-10 now available.

Write, Wire, Phone Your Requirements
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CRYSTALS
FOR ALL PURPOSES

LOW FREQ.-FT 241A for SSB, latice filter, ½" spc. 54th or 72nd harm channels listed by fund. Fractions omitted.

374	395	418	487	511	400	464	5910
375	396	419	488	514	440	466	6370
377	397	420	490	515	441	468	6450
379	398	422	491	516	442	470	6470
380	401	423	492	518	446	472	6497
381	403	424	493	519	447	474	6522
383	404	425	494	520	450	475	6547
384	405	426	495	522	452	476	6610
385	407	427	496	525	461	477	7350
386	408	431	497	526	462	479	7580
387	409	433	498	530	463	480	7810
388	411	435	503	531			
390	412	436	504	533			
391	413	481	506	537			
392	414	483	507	538			
393	415	484	508				
394	416	485	509				

99¢ ea. 10 for $9.00

SCR-522 ½ p ½" sp. — $1.29 each

BC-610 2 banana plugs ¾" spc. — 2030 2435 2045 2442 2105 2532 2125 2545 2145 2557 2155 3202 2220 3215 2258 3237 2280 3250 2282 3322 2290 3510 2300 3520 2305 3550 2320 3580 2360 3945 2390 3995 2415

Add 20¢ for each 10 xtals or less for postage and handling

49¢ each, 10 for $4.50 — $1.29 ea.

FT243-½" spc.

4190	6175	7773	1015	5725	5840	6306	6475	6640	7508	7706
5030	6208	7806	2045	5740	5850	6325	6506	6673	7540	7973
5485	6713	7840	3735	5760	5873	6340	6540	6706	7573	8240
6040	6873	7873	5305	5773	5906	6373	6573	6740	7606	8250
6073	6906	7906	5677	5800	5940	6406	6575	7440	7640	8273
6140	7740	7940	5706	5806	5973	6450	6600	7506	7650
				5825	6273	6473	6606		7673

49¢ ea. 10 for $4.50 — 99¢ each 10 for $9.00

Special Purchase! FM Radio Chassis

88-108 MC—Complete with 6 tubes, built-in antenna and speaker. Product of famous radio and TV maker whose name we promised not to mention $16.95
Maroon plastic cabinet for above 85.95.

TWO-STATION INTERCOM SYSTEM

Consists of master and remote station, 20-ft. of 3 wire cable. 115 V operation, AC or DC. Extra wire .05 per ft... $16.97

TV CHASSIS
NOT A KIT

Complete with picture tube and speaker. 20 tubes. Standard coil high gain cascode front end.

20-INCH: $157 | 17-INCH: $143

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PARTS DISTRIBUTORS, LTD.
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THE NEW **DYNATRACER***
Designed To DOUBLE YOUR PROFITS
CHECK SETS IN THE HOME
Makes TV servicing easier, faster and more accurate at LOW COST.
Trace signals and voltages—Locate defective components instantly.

*PAT. PEND.

Requires No Additional Equipment
"DYNATRACER" is a portable self-powered quality instrument that is used under actual operating conditions. "DYNATRACER" is designed to trace signals through any video, sound, sync, AFC, vertical or horizontal sweep circuit and instantly isolate trouble to a stage or component.

$4.95 Postpaid or COD plus postage

ADDED FEATURE:—
With a flick of the switch, the "DYNATRACER" will also trace voltages and instantly locate open, shorted or intermittent condensers, resistors, coils, speakers, transformers, etc. Complete Instructions and Trouble-Shooting Methods Enclosed. Satisfaction guaranteed.
Century instruments are quality engineered for accurate and efficient servicing.

CENTURY ELECTRONICS CO.
8509-21st Ave., Dept. 201, Brooklyn 14, N. Y.

(1) Your television set is one of the most intricate mechanisms in the world. To give you a perfect picture, its 1000 delicate, interdependent parts must work in complete harmony. With an instrument of such amazing complexity, it is entirely normal to expect occasional trouble. Moreover, there is no possible way of detecting all weak and failing parts. That's why a tube can be operating perfectly one minute and fail the next.

(2) Only a skilled technician should be trusted to adjust or replace parts in your television set. Your television service engineer is a trained electronic specialist, thoroughly qualified in all phases of TV servicing. He is a professional in every sense of the word, and performs a vital service at a modest price. Welcome him into your home.

The Greater Chicago service industry plans to use every medium to sell its services and contributions to the public. Radio, television, newspapers, direct mail, give-aways, billboards, posters, and even car ads are scheduled to be used to tell the public the truth about the television service industry to gain their understanding and good will.

To finance the program the Committee proposed an unusual plan that will permit each service operator to contribute in proportion to his volume of service business. In brief, the committee asks each member of the Greater Chicago TV service industry to notify his suppliers to add an additional charge of 1% to the wholesale cost of the TV parts he buys.

Following the development of this program by the Chicago Committee, the Television Service Association of Michigan for the Detroit area adopted the plan as did the Television Contractors Association of Philadelphia.

A complete service public relations program has been created for the Chicago Committee by *W. B. Doner and Company*, Chicago advertising agency. Material developed for this program is offered to service groups throughout the country through NARDA by the agency and the Chicago organization, the agency specifying only that it be retained by service groups in cities where it has offices.

Important Aspects of Plan

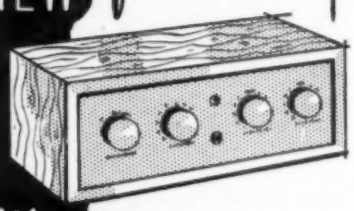
The most important factor about this plan is that it is completely financed by the service industry and thus can be a public relations program created for the service industry entirely in the interests of service business operators. Created and administered by a professional advertising agency, it will be employed in ways that will produce maximum effectiveness. It will do much to elevate the stature of service as a business by demonstrating in a practical way that service is able to stand on its own feet and fight its own battles.

It will not, of course, eliminate the necessity for each service business to advertise and promote its own indi-

"Advertisement"

"That reminds me . . . Order a new JENSEN NEEDLE for my record player."

NEW for Hi Fidelity



the New McGOHAN
PRE-AMPLIFIER, WA-300

- Radio and Auxiliary Inputs.
- Phono Compensation to LP, AES and Foreign Records.
- Built-In Power Supply.
- +15 DB to −15 DB.
- Less than .2% Distortion.
- 20-20,000 CPS.

the **NEW McGOHAN 300 SERIES for High Fidelity**

- WA-300 Pre-Amp.
- WA-301 Pre-Amp.
- WA-310 10 watt Amplifier with Controls.
- WA-312 12 watt Amplifier.
- WA-325 25 watt Amplifier.

See your Distributor or write to
M-G **DON McGOHAN INC.**
3700 W. Roosevelt Road
Chicago 24, Illinois

vidual facilities. But it will remove much of the tension between set owners and service technicians by wiping out misconceptions of TV service and service pricing.

The IRE Convention

Developments in transistors were considered to be the highlights of the annual IRE convention and exhibition but closed circuit television almost "stole the show."

Midget transistor-equipped transmitters and receivers were demonstrated. The *Bell Telephone Labs* exhibited the step-by-step progress in the development of transistors together with many of their applications in telephony. *Bell* engineers pointed out that they did not expect transistors to replace vacuum tubes in telephony electronic applications but that they would make possible new electronic devices that would have been too expensive with vacuum tubes. As an illustration they showed a miniature telephone line amplifier that would fit into the regular telephone line cord.

The television camera for closed circuit applications has captured widespread industry interest since the introduction of the *Dage* camera about six months ago. It is expected that closed circuit television will eventually be a much larger business than television for home entertainment. *Du Mont* displayed a portable Vidicon-equipped camera at the show; *RCA* is said to be readying a new unit which will soon be unveiled and it is rumored that a number of other manufacturers will soon be announcing TV cameras for closed circuit work.

New G-E Picture Tube

One product of interest to all TV service technicians introduced at the IRE show was *G-E's* new picture tube with the "internal magnetic focus" gun.

The new gun contains an internal compensating focusing lens which maintains focus over a wide range of operating voltages, according to Mr. Grady L. Roark, manager of *G-E* equipment tube sales. A simple shunt may be used to increase this range. No external focusing control requiring set owner adjustment is necessary. See page 82 of this issue for additional details.

NIESA at Convention

The National Industrial Electronic Service Affiliates, Inc., which was organized last Fall, were contacted by many manufacturers interested in the kind of top-flight maintenance such an organization of independent service companies can provide. More than twenty-five major service companies located in as many cities are now affiliated in the NIESA organization.

Manufacturers of nucleonic instruments for medical use, induction and dielectric heating apparatus, color and black-and-white television for closed circuit work, and other electronics equipment for industrial applications

70% to 90% off list!

TOP TUBE BUYS

All Tubes Individually Boxed! Check this list for Rigidly-Tested, Full One-Year Guaranteed Tubes.

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
1A5GT	.30	5V4	.73	6BL7	.59	6W6GT	.44	19T8	.79
1A6G	.30	5W4	.50	6BQ6GT	.59	6X4	.37	19V8	.89
1A7GT	.47	5X4	.40	6BQ7	.95	6X5GT	.37	24A	.63
1AB5	.30	5Y3G	.32	6BZ7	.95	6X8	.61	25AV5	.83
1B3	.65	5Y3GT	.32	6C4	.37	6Y6G	.48	25BQ6GT	.62
1B5	.30	5Y4G	.35	6C5GT	.39	7A4	.47	25L6GT	.39
1B7GT	.30	5Z3	.46	6C6	.58	7AF7	.53	25W4	.56
1C5GT	.43	6A7	.59	6C8G	.24	7B4	.44	25Z5	.40
1E7	.29	6A8	.62	6CB6	.44	7C6	.40	25Z6GT	.37
1G4GT	.24	6AB4	.44	6CD6G	1.11	7E6	.30	26	.45
1G6	.30	6AG5	.43	6D6	.48	7X7	.70	27	.39
1H4G	.30	6AJ5	.90	6E5	.48	12A8	.61	32L7	.69
1H5GT	.40	6AK5	.75	6F5GT	.39	12AL5	.37	35B5	.40
1H6	.24	6AL5	.38	6F6	.37	12AT6	.37	35C5	.39
1J6	.24	6AQ5	.39	6F8G	.24	12AT7	.56	35L6GT	.41
1L4	.46	6AQ6	.37	6G6G	.52	12AU6	.38	35W4	.37
1LC5	.51	6AR5	.37	6H6GT	.41	12AU7	.43	35Z4	.39
1N5	.46	6AS5	.50	6J5GT	.37	12AV6	.39	35Z5GT	.37
1P5	.57	6AT6	.37	6J6	.52	12AV7	.59	36	.60
1Q5	.58	6AU6	.38	6J7G	.43	12AX4	.48	41	.42
1R5	.45	6AV5	.83	6J8	.30	12AX7	.48	42	.42
1S5	.39	6AV6	.37	6K5	.47	12AZ7	.69	43	.55
1T4	.45	6AX4	.53	6K6GT	.37	12BA6	.38	45	.55
1T5	.53	6AX6G	.24	6K7	.44	12BA7	.60	45Z5	.49
1U4	.45	6B4G	.64	6L5	.24	12BD6	.45	50B5	.39
1U5	.39	6BA6	.39	6L6	.64	12BE6	.39	50C5	.39
1V	.60	6BA7	.57	6Q7	.45	12BF6	.39	50C6	.59
1X2	.63	6BC5	.44	6S4	.38	12BH7	.63	50L6GT	.41
2A3	.70	6BC7	.34	6S8	.53	12BY7	.65	50Y7	.50
2A4G	.24	6BD5GT	.89	6SA7GT	.43	12C8	.34	53	.24
2X2	1.50	6BD6	.45	6SD7GT	.41	12F5GT	.34	56	.24
3A4	.45	6BE6	.39	6SF5GT	.46	12J5GT	.42	57	.58
3E5	.46	6BF5	.41	6SG7GT	.41	12J7GT	.34	58	.60
3Q4	.48	6BF6	.37	6SH7	.73	12K7GT	.34	70L7GT	1.09
3Q5GT	.49	6BG6G	1.25	6SJ7GT	.41	12S8	.70	75	.41
3S4	.46	6BH6	.46	6SK7GT	.41	12SA7GT	.44	76	.44
3V4	.47	6BJ6	.39	6SL7GT	.48	12SF5	.50	77	.57
5U4G	.45	6BK7	.59	6SN7GT	.52	12SG7GT	.52	78	.47
				6SQ7GT	.37	12SJ7	.44	80	.35
				6SR7GT	.45	12SK7GT	.48	83V	.68
				6SS7	.42	12SL7GT	.47	85	.59
				6T8	.56	12SN7GT	.52	117L7	.99
				6U4	.60	12SQ7	.44	117Z3	.37
				6U5	.44	12SR7	.49	807	.99
				6U6	.63	14J7	.30	1274	.99
				6U8	.61	14W7	.30	2050	1.85
				6V6GT	.39	19BG6G	.95	6113	1.00
				6W4GT	.44	19C8	.70		

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In FT 241-A Holders—½ in. Pin SPC. These are designated 54th or 72nd Harmonic MC freq. Listed by fundamental freq. with fractions omitted.

370	396	420	443	469	494
372	397	422	446	470	496
374	398	423	447	472	496
376	400	424	448	473	497
376	401	425	450	474	498
377	402	426	451	475	501
379	403	427	452	476	502
380	404	429	453	477	503
381	405	430	454	479	504
383	406	431	455	480	505
384	407	433	456	481	506
385	408	434	457	482	507
386	409	435	458	484	508
387	411	436	459	485	509
388	412	437	461	486	511
390	413	438	462	487	512
392	414	440	463	488	513
393	415	441	464	490	514
393	416	442	465	491	516
394	418	443	466	492	516
395	419	444	468	493	

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Equipped with tuning knobs
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BC-223 25 W. TRANSMITTER & ARR RECEIVER: For 24 V. inst. Receiver covers beacon, standard, and b'cast marine frequencies and amateur bands. This combo makes the finest LOW-COST marine installation on the market. Complete, checked out, ready to go. The whole deal ONLY.....$185.00
Write in for conversion info for 12 V. inst.
DU-1 LOOP uses ARR RECEIVER one of the best radio compass units made. With conversion dope. Used cond.....$32.50
JEFFERSON-TRAVIS MARINE 5 W. RADIOTELEPHONE: Made by Emerson Radio Corp. 2-channel, crystal controlled receiver & transmitter. F.B. for small boats with 6 V. system or sail boat. Will run 48 hrs. on standard 6V. car battery. Complete with tubes, instructions, but less crystals and battery. NEW.....$79.50
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PE-104 VIBRATOR: Part of BC-654 Trans. Rec. 6 or 12 V. Input. Output, positive: 6, 14 and 84 VDC.; negative: 1.4, 6, 12, 51 VDC. NEW with spare parts.....$10.95
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have shown a keen interest in the facilities available to them through NIESA. Independently owned and managed service businesses with the trained personnel, facilities, and equipment for handling a wide variety of electronic service work, can handle maintenance contracts far more efficiently and economically than factory-operated branches.

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RTTG of New England

In a recent letter to technicians who attended the initial meeting leading toward the formation of a strong sectional association of television technicians, A. C. W. Saunders lauded the men who attended for their fine spirit of cooperation. Mr. Saunders, who has long been associated with movements intended to improve the position of electronics servicing work as a professional activity, said:

"I want to congratulate all those who participated in the meeting of radio and television technicians from various sections of New England held in Providence recently. It impressed me to such an extent that I am compelled to put my feeling into words.

"Here I witnessed a gathering of honest, sincere, unselfish men of our industry lay the foundation for the formation of a Radio Television Technician Guild of New England.

"As the meeting progressed, I witnessed the laying of the foundation—A Code of Ethics—on which the Guild is to be built. In this foundation I could see the ties of friendship and public relations going into place with a corner stone dedicated to the general public.

"The team work of those present in preparing this foundation spelled *success.* It was the first time in my 25 years of organization work that I have observed constructive criticism without heated debate. This mutual accord, I am sure, cemented the flawless foundation.

"I witnessed the supports of this ideal being erected on the foundation when the purpose of the organization was read and I saw the beginning of a six-state Guild taking shape. Then welcome was extended to all those in the industry who subscribe to the principles laid down in the foundation —*The Code of Ethics,* and the strength of its structure—*The Purpose.*

"I write this message appealing for all who subscribe to the completion of such an ideal, because it is the brotherly feeling among us that will give guidance and solution to our many problems.

"This infant institution should strike a harmonious chord with all technicians who are ambitious to increase their technical skill and improve their standards of living." —30—

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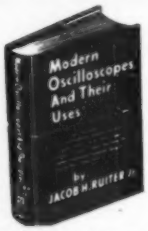

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OUTSIDE U.S.A.—Price $6.50 cash only. Money back in 10 days if book is returned.

Within the Industry

(*Continued from page 26*)

television sets and a revised radio production estimate of 10,934,872 units. This compares with 5,384,798 TV sets and 12,627,362 radios in 1951. The dollar value in 1951 was set at approximately $1,272,922,897.

* * *

LEON PODOLSKY has been appointed to the newly-created post of technical assistant to the president of *Sprague Electric Co.*, North Adams, Mass. He was formerly manager of field engineering.

Among his new duties will be that of consultant on field engineering problems, supervision of the company's carrier-current development program, and representation of the company in the national trade association and international standards work.

* * *

MASSACHUSETTS INSTITUTE OF TECHNOLOGY has announced that it will offer a special summer program in transistors and their applications from July 20 to 31 during the 1953 summer session.

Enrollment will be limited with preference being given to those having college specialization in physics or electrical engineering.

Further information and application blanks may be obtained from the Director of the Summer Session, Room 3-107, Massachusetts Institute of Technology, Cambridge 39, Mass. —30—

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96	University of Illinois
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ERRATA

In the circuit diagram, Fig. 2, appearing on page 58 of the April issue (Modified Childs' Amplifier-Power Supply) the VR75 next to ground should be a VR105 tube. Condenser C_5 should be a .05 μfd. molded plastic condenser instead of the mica unit specified in the parts list.

* * *

Fig. 5, page 45, of the April issue (20-Watt 6 Band Mobile) should be corrected as follows: the parallel combination of PL_1 and R_{12} should be in series with the plate lead of the 2E26, between C_{16} and RFC_{10} with condenser C_{18} connected to the cold end of RFC_{10}. C_{11} should be connected to pin 4 of the 6BQ6GT.

* * *

In the parts list accompanying the article appearing on page 71 (The Modern Booster) of the April issue, the coil form for L_1 and L_2 was incorrectly listed as ¼" o.d. This should be ⅜" o.d., with fitting slug.

DON'T PASS THIS BUY

LINK & BOSCH MOBILE POLICE RECEIVERS, 5 tubes (RF stage) fixed tunable 2-3 mc, adj. squelch control, W/6 volt power supply, 230V/100 ma. IDEAL/Ham, C.D. MARS & MARINE services. Makes hot recvr w/HF converter, used operating cond. With new 5" PM spkr.....$12.95

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NEW 6 & 12 VOLT DYNAMOTOR, 180 V/50 ma, 300 V/150 ma, higher ratings on 12 V. 11.95

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SIGMA 5R 130 ohm, operates 2-24 VDC	2.45
SIGMA 41F 10K ohm .04 watt AC/DC SPDT	1.75
KURMAN RK-35 10,000 ohm/.5ma	4.95
G.E. COMPACT, 10,000 ohm/1.5ma SPNO	1.65
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SPECIAL 90 VAC SYNCRO CAPACITORS

3x .6 mf	$2.75	3x 3 mf	$3.75
3x10 mf	5.95	3x50 mf	7.95
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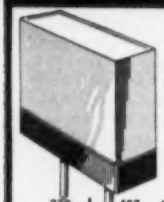

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500 KC Crystals $1.95
1000 KC Crystals $3.95
200 KC Crystals

370	407	444	476	509
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381	416	453	486	519
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385	420	456	490	523
386	422	457	491	525
387	423	458	492	526
388	424	459	493	527
390	425	461	494	529
391	426	462	495	530
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395	431	466	501	536
396	433	468	502	537
397	434	469	503	538
398	435	470	504	540
400	436	472	505	
401	437	473	506	
402	438	474	507	
403	440	475	508	
404	441			
405	442			
406	443			

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Rocket 115K—
Latest superhet circuit designed for the ultimate in sensitive reception and tonal quality. Beautiful slide rule dial. Consists of all necessary parts, punched and stamped chassis, attractive bakelite mahogany cabinet, built-in loop antenna, iron core I.F. transformers, large 5" Alnico V speaker, tube complement: 1—12SK7, 1—12SA7, 1—12SQ7, 1—50L6, 1—35Z5. Tunes standard AM broadcasts from 540 to 1700Kc. Automatic volume control and beam power circuit. **$14.75**

Plaza 812K—
Deluxe 2-Band AC/DC superhet receiver. Designed for excellent sensitivity and signal pickup. Covers standard American Broadcast Band 535 to 1800Kc and foreign short wave transmissions 6 to 18Mc (16.6 to 50 meters). Features: Impregnated matched coils, iron core I.F. transformers, bass-treble tone control, large 5" Alnico V speaker of excellent tonal quality, and Phono Jack. Handsome cabinet of mahogany bakelite—measures 11½"x8"x8¾". Complete with tubes, 1—12SK7, 1—28A7, 1—12SQ7, 1—50L6, 1—35Z5, finest quality parts, stamped and punched chassis for quick-easy assembly. **$20.75**

Globemaster 814K—
Super-sensitive—3-Band receiver featuring latest in Broadcast and short wave design. Uses impregnated matched coils, permeability tuned I.F. transformers. Molded tube sockets, special local-distance band switch position for superb foreign and domestic reception. Bass-treble tone control. Phono input jack, heavy duty 6 Alnico V speaker. Covers standard broadcast from 535Kc. to 1800Kc. Two short wave bands include: 1.8Mc. to 6Mc. and 6Mc. to 18Mc. Kit is complete with all necessary parts, tubes (1—12SK7, 1—12SA7, 1—12SQ7, 1—50L6, 1—35Z5), Punched and formed chassis, coils, dial and pointer, knobs and distinctive mahogany bakelite cabinet: size—15"x10"x7". **$24.75**

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INDEX OF Advertisers

JUNE 1953

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ADVERTISER	PAGE
Ace Television	128
Airex Radio Corp.	147
All Channel Antenna Corp.	85
Allied Radio Corp	9
American Television & Radio Co.	123
Amplifier Corp. of America	118
Arkay Radio Kits, Inc.	114
Arrow Electronics	150
Arrow Sales Inc.	135
Asco Sound Corporation	161
Ashe, Walter, Radio Company	105
Audak Company	100
Audel, Publishers	138
Bell Telephone Laboratories	6, 106
Boulevard Electronics, Inc.	129
Brook Electronics, Inc.	126
Brush Electronics Company	151
C & H Sales Co.	160
Candler System Co.	104
Cannon Electric Co.	14
Capitol Radio Engineering Institute	95
CBS-Hytron	83
Centralab	32
Century Electronic Co.	154
Channel Master Corporation	80, 81
Cleveland Institute of Radio Electronics	103
Collins Audio Products Co., Inc.	27
Columbia Electronic Sales	158
Commissioned Electronics Co.	143
Communications Equipment Co.	82
Concord Radio	136
Cordover, Carl & Co.	88
Corona Radio & TV Co.	160
Coyne School	108
Crest Laboratories, Inc.	149
DeForest's Training, Inc.	5
Delco Radio	97
Editors & Engineers Limited	102
Electronic Instrument Co., Inc.	34, 144
Electronic Specialty Supply Co.	119, 159
Electro-Voice	8
Fair Radio Sales	104
Federal Telephone & Radio Corporation	3rd Cover
Fisher Radio Corporation	16
Franklin Technical Institute	104
Garrard Sales Corp.	142
G. L. Electronics	116
General Electric Company	12, 13
General Test Equipment	110
Good, Don, Inc.	143
Goodheart, R. E.	110
Greenlee Tool Co.	108
Greenwich Sales Company	145
Hallicrafters	7
Harjo Sales Co.	152
Harvey Radio Company, Inc.	102, 144
Heath Company	73, 76
Henry Radio Stores	92
Henshaw Radio Supply	154
Hi-Lite Electronic Sales Co.	159
Hudson Radio & Television Corp.	118
Hughes Research & Development Laboratories	90, 146
Illinois Condenser Co.	94
Indiana Technical College	161
Instructograph Company	149
International Correspondence Schools	11
International Resistance Company	115
JFD Manufacturing Company, Inc.	79
JSH Sales Co.	136
Jensen Industries, Inc.	154
J. S. C.	149
Jones & Laughlin Steel Corporation	121
Kaar Engineering Company	117
Kirk, Jim	127
Kloss Industries	141
Krylon, Inc.	134
L. A. Ham Shack	157
LaFayette Radio	108, 109
LaPointe Electronics Inc.	22, 23
Lee Electronic Lab., Inc.	146
Leeds Radio Co.	94
Leotone Radio Corp.	153
Link Aviation, Inc.	91
McGee Radio Company	86, 87
McGohan, Don, Inc.	154
McGraw-Hill Book Co., Inc.	148
McIntosh Laboratory, Inc.	106
Mallory, P. R., & Company	4th Cover
Mattison Television & Radio Corp.	150
Michel Mfg. Co.	126
Miles Reproducer Co., Inc.	106
Milwaukee School of Engineering	138
Moss Electronic Distributing Co., Inc.	101
National Company	127
National Electronics of Cleveland	94
National Radio Institute	3
National Schools	19
Newark Electric Company	114
Newark Surplus Materials Co.	122
Newcomb Audio Products Co.	24
Olson Radio Warehouse	125
Olympic Electronics Supply	122
Peak Electronics Co.	120
Perma-Power Company	153
Philco Corporation	28
Phillips Tube Company	114
Photocon Sales	144
Pickering & Company Incorporated	30
Platt Electronics Corp.	113
Premier TV Radio Supply	107
Progressive Electronics Co.	155
Pyramid Electrical Company	21
RCA Institutes, Inc.	111, 127
R W Electronics	78
Radiart Corporation, The	10
Rad Tel Tube Co.	157
Radio City Products Co., Inc.	130
Radio Corporation of America	2nd Cover
Radio Craftsmen Inc.	112
Radio Products Sales Co.	126
Radio Receptor Company, Inc.	132
Radio-Television Training Association	25
Rauland Corporation, The	89
Raytheon Manufacturing Co.	31
Regency	137
Rinehart Books, Inc.	90, 150, 158
Rohn Manufacturing Company	159
Rose Co., The	152
Rytel Electronics Mfg. Co.	26, 146
Sams, Howard W. & Co., Inc.	77, 142
Sanagame Electric Co.	145
Schott, Walter L., Co.	17
Service Instruments Company	158
Simpson Electric Company	110
South River Metal Products Co., Inc.	118
Sprague Products Company	15
Sprayberry Academy of Radio	29
Stan-Burn Radio & Electronics Co.	137
Standard Transformer Corporation	131
Stephen Sales Corp.	102
Steve-El Electronics Corp.	90
Stevens Walden, Inc.	140
Sun Parts Distributors, Ltd.	156
Sylvania Electric Products, Inc.	33
TAB	162
Tech-Master Products Co.	152
Technical Appliance Corporation	128
Telemarine Communications Co.	96
Telephone Engineering Company	128
Television Communications Institute	153
Television Hardware Mfg. Co.	20
Television Materials Corp.	128
Television Remote Control Co.	127
Terado Company	124
Thordarson-Meissner	154
Transvision, Inc.	98, 99, 136
Triad Transformer Corp.	84
Trio Manufacturing Co.	93
Tri-State College	145
Tung-Sol Electric, Inc.	122
Turner Company, The	141
Ungar Electric Tools, Inc.	132
United Technical Laboratories	143
Valparaiso Technical Institute	110
Van Sickle Radio Supply Co.	106
V & H Radio & Electronics	138
Visulite Co.	147
Waldom Electronics, Inc.	142
Weller Electric Corp.	161
Wells Sales, Inc.	155
Western Electronics Co.	154
Western Television Institute	114
Wholesale Radio Parts Co., Inc.	133
Windsor Electronic Tube Co.	126
World Radio Laboratories	139

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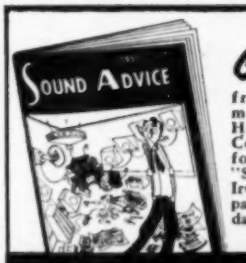

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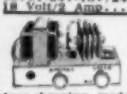

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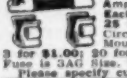

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950VCT /100MA. 5V/5A, 5V/2.5A, 45V/1A, 10V/1.5A.....**$5.49**
900V /35MA. 2x2.5V/2A, xcint 1800-Vdhlw two 2x3 SL windgs hald.....2.25
840VCT /110MA. 530vct/21ma, 2x5V /3A, 6.3vct/1A, 6.3vct/3A.....3.49
780VCT /250MA. 5V/6A, 12.6V/5.5A **$7.95**
770VCT /200MA, 5V/6A, 12.6V/5.5A 6.95
760VCT /120MA, 2.5vct/10A, 6.3vct/2A 5V/3A, 10V/3.25A.....6.98
700VCT /120MA. 2x6.3V/3A, 6.3V/1A.....**$3.98; 2 for 7.25**
550VCT /150MADC, 5V/3A, 6.3V/5A. 5.25
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230VAC Vibrator Trans.$1.49; 2/ 2.25

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High Quality Forged, Tempered Tool Steel. 6¼" Adj Wrench, 5½" Long Nose Pliers, 5¾" Cutters With Carry Case.....**$2.25**
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Write for List of Elements and Tips
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(4) **36V** Batt/acid.....3.35
2V/20AH Battery with 2 Volt Vibrator.....2.98
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6V/6AH Wild NT6/BB214U.....2.98
6V/6AH Battery w/acid.....3.29
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0A2	$0.95	3D23	4.90	6SG7	.72	117P7GT	1.39	801A	.45		
0A3/VR75	1.04	3E29	14.95	6SN7	.61	117Z6GT	1.31	803	3.80		
0B2	1.19	4-125A	14.95	6SQ7	.70	117Z6GT	1.31	804	3.80		
0B3/VR90	1.09	4-250A	40.00	6SK7GT	.69	VT127A	3.90	807	1.65		
0B3/VR105	1.15	4C35	22.25	6SL7GT	.99	CV140	4.98	808	2.59		
0D3/VR150	1.15	4CX250B	18.98	6SN7GT	.70	F0125	29.00	809	3.95		
1B3/8016	.81	5C21/C6J	6.95	6SN7WGT	2.25	FG172	29.00	810	9.95		
1B21/471A	2.85	5C22	42.05	6SQ7GT	.63	250TH	2.25	811	2.90		
1B22	2.85	5CP1/CSG	9.95	6SR7	.69	250TL	2.25	812	3.50		
1B23	3.90	5D21	10.50	6SS7	.75	304TH	8.90	813	12.49		
1B24	9.48	5D22		6ST7	.88	304TL	8.90	814	2.87		
1B26	2.85	5FP7	36.50	6SU7GTY	.87	311A	6.98	815	2.98		
1B27	12.75	5J29	12.40	6V6	1.39	388A	1.49	816/866Jr.	1.07		
1B32/532A	3.90	5R4GY	1.95	6VGGT	.57	WL417A	8.98	826	.95		
1B35	2.15	5R4WGY	1.49	6W4GT	.67	411A		828	11.49		
1B37	18.50	5AQ5	.79	12AH7GT	1.45	5842	16.50	829B	12.45		
1B38	29.95	6A8T	1.39	12AK5	1.08	GL434A	13.49	832	7.65		
1B40	4.98	6AH6G	1.49	12AL5	.75	450TH	45.00	832A	9.95		
1B41	4.98	6AK5	1.49	12AL5	.75	450TH	45.00	833A	39.45		
1B42	18.00	6AJ5	1.40	12AT6	.52	304TL	52.00	834	6.95		
1B43	1.98	6AK5	.79	12AT6		4W-HF200		836	2.98		
1B46	3.98	6AK5W	2.98	12AU6	.72		15.95	837	1.45		
1B56	38.50	6AK6	1.05	12AU7	.63	GL471A	3.65	840	39.45		
1B58	175.00	6AL5	1.49	12AV6	.63	GL410	3.65	841	2.98		
1B59	175.00	6AL7GT	1.39	12AV7	.98	CK501AX	3.20	861	23.95		
1B63	50.00	6AN5	2.90	12AW6	1.70	CK502AX	1.49	865	1.29		
1B63A	75.00	6AQ5		12AX4GT	1.70	CK503AX	1.49	872A	1.29		
2C36	27.00	6AQ5W	3.98	12AX7	.79	CK505AX	1.79	872A	3.29		
2C39	21.00	6AQ6	1.49	12AY7	2.95	CK506AX	1.49	CK1008	.85		
2C39A	39.50	6AQ7GT	1.39	12AZ7	1.49	CK507AX	0.98	CK5647	3.98		
2C40	7.95	6AR5	1.39	12BA6	.99	CK509AX	1.45	5654	2.79		
2C43	17.75	6AR6	2.98	12BA7	.79	CK512AX	1.45	5670	6.30		
2C43/4654A	9.40	6AS5	2.79	12BE6	.79	CK522AX	1.25	CK5672	2.98		
2C44	1.49	6AS6	2.79	12BE6	.80	CK524AX	1.49	CK5678	1.89		
2C51	1.49	6AS7G	4.69	12BF6	.85	CK526AX	1.49	5687	5.49		
2D21	1.29	6AT6	1.03	12BH7	.89	CK528AX	1.49	CK5702	1.49		
2E41	1.49	6AT6T	1.03	12BH7	.89	CK529AX	1.49	CK5703	1.49		
2E42	1.49	6AU6	1.39	12BZ7	1.25	GL830	22.00	Xtal Diodes			
2E43	1.49	6AV6GT	1.39	12BZ7GT	.60	CK531DX	1.89	1N21A	$1.55		
2E44	1.49	6AW6	1.39	12BC7	.60	CK532DX	1.89	1N21B	2.89		
2J31	37.00	6AW8	1.49	12SF5GT	.72	CK532DX	1.89	1N21C	21.50		
2J31A	79.95	6B4G	1.27	12SF7GT	.49	WL532	1.98	1N22	1.25		
2J32	37.00	6B7	1.27	12SG7	.63	CK534AX	1.98	1N23	1.25		
2J33	37.00	6B8	1.27	12SH7	.63	CK534AX	.98	1N23A	2.20		
2J34	27.00	6BC5	1.03	12SJ7GT	.59	CK536AX	.98	1N23B	3.49		
2J38	100.00	6BD5GT	1.45	12SK7	3.65	CK538DX	.98	1N25	3.49		
2J38	11.75	6BD6	1.45	12SL7GT	.98	CK538DX	.98	1N26	8.75		
2J39	44.00	6BF5	.98	12SN7GT	.75	CK539DX	2.15	1N27	1.85		
2J39	44.00	6BF6	.98	12SQ7GT	.75	CK540DX	2.15	1N34	.45		
2J40	34.25	6BF6	.98	12SR7	.83	CK542DX	.99	1N34A	.90		
2J48	34.25	6BG6G	2.98	FG17	3.95	CK543DX	.99	1N35	1.65		
2J49	67.25	6BG6G	1.10	19V8	1.62	CK544DX	.99	1N38	1.15		
2J50	11.25	6BG7	1.98	RK20A	8.95	CK546DX	1.98	1N38A	1.15		
2J52	249.50	6BH6	.69	246 /3C24	8.95	CK547DX	1.98	1N39	4.15		
2J53	88.00	6BJ6	.69	250R065T	1.19	CK572AX/ 5886	2.49	1N39A	5.95		
2J55	1.00	6BK5	2.15	25L6GT	.69	CK572AX/		1N42	16.95		
2J61	49.95	6BN7GT	1.45	25Z5GT	.99	6094	3.49	1N43	1.73		
2J62	49.45	6BN8	1.45	25Z6GT	.99	WL672	117.00	1N45	1.45		
2K28	49.45	6BN8	1.69	FG27A	8.70	WL676	39.95	1N46	.69		
2K32	39.45	6BQ6GT	1.69	35A5	1.59	WL686	39.95	1N47	4.00		
2K35	39.49	6BQ7	1.69	FG32/ 5508	13.95	703A	4.75	1N48	.85		
2K45/ 723AB	24.90	6BY5G	1.45	35Z5GT	13.95	705A	1.98	1N51	.45		
2K48	39.00	6C4	29.95	35Z5GT	.55	707A	7.90	1N52	1.39		
2K49	39.00	6C8G	.69	RK39	2.89	707B	17.50	1N53	2.07		
2K53	289.00	6CD6G	1.69	RK48	6.85	715A	8.00	1N54A	1.15		
2K54	289.00	6CG7GT	1.45	RK49	7.50	715B	11.98	1N55A	4.00		
2K41	126.00	C6J/SC21	6.95	SOL6GT	.99	715C	34.00	1N56	.89		
2K48	130.00	6J4	6.66	RK61/XFG1	3.00	717A	.90	1N57	.89		
2K51	.49	6J6GT	.67	81	.81	718BY	48.45	1N58	1.15		
2K52	2.70	6J6	.63	81	1.15	718CY	48.45	1N58A	1.15		
2K53/RK32	4.95	6K4A	6.45	82	1.15	721A	2.49	1N61	2.07		
2K54	4.50	6L6	1.35	83V	1.75	722A/387	2.45	1N63/RK65	2.49		
2K56	4.50	6L6G	1.35	83	.79	723A/B	11.98	1N65	.69		
2K58	3.70	6L6GA	1.35	83V	1.75	724A/B	11.98	1N66	.69		
2K59	7.90	6L6GAY	2.29	FG95/ 5560	34.95	724B	3.95	1N69	.98		
2K23	9.90	6L6GAY	2.29	FG95/	34.95	724C	3.95	1N69A	1.79		
2K31/ C1B	9.90	6SA7GTY	3.37	FG96	7.49	725A	3.45	1N70	1.79		
2K33	14.98	6SD7GT	1.19	100TH	7.83	726A	8.49	1N70A	3.50		
2K45	13.89	6SC7	.90	FG104	37.98	726B	14.95	1N82	1.15		
2K50/ 1599	4.98	6SD7GT	.80	FG105	17.64	726C	45.00	1N83	1.15		
2K21A	4.98	6SF5	.77	117L/87GT	1.49	730A	79.95	1N84	1.15		
3D22	13.95	117N7GT	2.15	117N7GT	2.15	726C	79.95	1N88	1.15		

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The man who brought back a smile

EXCITED? Cynthia was practically bursting! Last thing Dad said was "Now you look close, Cindy. You'll see me right there in the audience tonight, and I'll wave to you." (They always do!)

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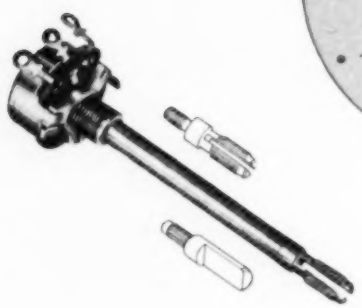

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